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Good Housekeeping—a Legal Obligation?

Unheralded, a private member's Bill called the Factory (Foundry Workers) (Health and Safety) Act, 1952, last Friday was read a second time without a division. The scope of the Bill is not so wide as its title would indicate, for it is confined to ironfoundry practice. Actually, its object is to make the suggestions of the "Garrett Report" statutory obligations. The section dealing with tidyness, that is, the stacking of boxes and clear gangways, will meet with general approbation even by the smallest foundries. The next section, which prohibits the use of portable coal, coke and wood fires, will be regretted by many of the old-timers, whose method is to light a fire in the open air and, when it is burning brightly, to carry it into the shop and position it to leeward. The ban extends to the use of fire buckets for drying ladles, and thus an interesting field is opened up for makers of alternative methods of heating. If their use be unavoidable, then fume extraction plant apparatus will have to be installed.

For the small jobbing foundry, the provisions detailed in the section dealing with the knock-out and fettling areas will create many headaches, as these will be required to be segregated from the rest of the operations. However, the interpretation of the word "segregated" can be fairly elastic. In any case, many snags will have to be overcome. There is also the need of an exhaust or general ventilation. The installation of the new plant for this purpose is no job for the amateur, as we have known it to aggravate rather than cure dust and fume problems. The Bill proposes that these must be provided for each man in certain jobs a complete outfit of protective clothing ranging from boots to goggles, but has omitted hard hats, despite the fact that most accidents come from falling bodies. There is no corresponding clause, however, that operatives must wear the articles issued to them. We are firmly of the opinion that if operatives were made to pay just a fraction of their cost, they would appreciate better their value. The adage "Owt for nowt is not worth having" still applies. The next provision is that baths, changing rooms and lockers for the use of their operatives will have to be installed in all iron foundries. This will be so heavy a charge on the smaller concerns that they may very well be unable to bear it. In some cases there would be greater efficiency, if baths were installed in employees' homes—where they quite often return for their mid-day meal. If their homes already have such facilities, then the installation of baths in village foundries is unnecessary. Much depends on the location of the foundry.

Now that the Bill has passed its second reading, any protests which the industry wish to make will have to be lodged reasonably quickly. The passing of the Bill will not affect most of the larger concerns. The adoption of at least one new foundry process will tend to make the work as clean as that in machine-shops, and this should be taken into consideration in the wording of the Bill. We sincerely trust that the sponsors' hope that the Bill will reduce accidents will be fulfilled. Certainly, added interest will be given to the annual report of H.M. Chief Inspector of Factories. In general, the Bill is not a good advertisement for the industry.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

SHELL-MOULDING DEVELOPMENTS

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I have read with interest the article on shell-moulding developments (JOURNAL, December 4) and fully realize how important this new technique is to industry. I feel, however, that if the article is taken at face value much harm can be done to its standing unless certain points are emphasized more clearly. To that end I wish to put the following questions.

(1) It is stated that the moulds are made from resin-bonded sand, also that "due to the fine structure of the sand used, the surface of the shell follows the contours of the pattern extremely closely." From these points it would seem that a sand free from natural clay and of a particular grain size is used. Is this a standard sand readily available and is the sand used over and over again; if so, does the ash content build up and reduce the permeability? If the sand is only used once, then surely this item should have been shown in the sample of costing.

(2) In the article it is said that the two half-moulds are held together by clips or soft-iron nails. Surely the hydrostatic pressure would burst these apart. Is no jointing adhesive used? In the "Johannes Croning" or "C" process, it was advocated that the moulds should be buried in iron shot.

(3) Is not the cost of patternmaking somewhat glossed over? If the true figure of this item alone were added to the overheads there would not be such a wide difference. All wooden and white-metal patterns are ruled out, this means that the patterns must be made from aluminium, other non-ferrous or ferrous metals. In making the patterns, the working temperature of the patternplate must be taken into consideration, since a metal pattern at 160 deg. C. will be larger than at room temperature, so this factor must be added to the normal contraction allowance. No soft solder can be used for fillets around the pattern or for any modifications and the standard of finish on the pattern must be high.

(4) With regard to accuracy, subject to a good mould-to-pattern fidelity, the degree obtainable is dependant on the patternmaker. Personally, if I wanted a metal pattern to ± 0.002 in. tolerances and with cast threads, etc., I would give it to a die-sinker to make, for very few patternshops have the machinery for such jobs. Compared with a wooden pattern costing, say, £40, similar equipment for shell moulding would be about £150 and would require for manufacture about three to four months. Of course, this is only where great dimensional accuracy is required; the costs of patterns to normal standards would be lower but yet still be higher than the average foundry patternplate.

The technical staff of Polygram Casting Company, Limited, are to be commended on a very fine achievement; the development work on this process must have cost many headaches and they have every right to be proud of their results.—Yours, etc.,

J. A. F. JARVIS.

19, Coed Glas,
Penywaun,
Aberdare,
Glam.
December 11, 1952.

NODULAR IRON PATENTS

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—We note with interest the announcement in your JOURNAL of December 11, 1952, regarding the allowance by the Patent Office to the Mond Nickel Company of their patent No. 630,070. In view of the widespread public interest in the opposition proceedings to this Patent, instituted by the Meehanite Metal Corporation, we believe your readers should know that this case was heard in the British Patent Office Court under the laws of the old Patent and Designs Act of 1907-1946 which has only recently been amended; but as any amendment of the law is not retroactive the Meehanite Metal Corporation was accordingly restricted in the evidence it could use in this case.

The Meehanite Metal Corporation therefore early recognized that a Patent would eventually issue once the application was accepted and published under this older act, but if it did, it would not be necessarily valid as this could only be determined by revocation or infringement proceedings in the High Courts and not by the Patent Office. The validity of the Mond Nickel Company's Patent still awaits such a test.

As to the results of this opposition case, the test between the Meehanite Metal Corporation and the Mond Nickel Company was not one of the validity of their alleged invention, but as to whether their Patent Specification should be granted without correction and inclusion of the prior use of magnesium in grey cast iron as taught by the Meehanite Metal Corporation Patents U.S. Nos. 1,683,086 and 1,683,087, British No. 312,126 and German No. 541,296. In this the Meehanite Metal Corporation was completely successful, and the Mond Nickel Company has been instructed to recognize the prior invention of the Meehanite Metal Corporation who made "nodular" cast iron having increased tensile and transverse strength properties as far back as the year 1926.

The contest between the two companies was one of limiting the rights of the Mond Nickel Company and this has been accomplished. Proof of the success of the Meehanite Metal Corporation in this matter was the awarding of costs in this case against the Mond Nickel Company.—Yours, etc.,

E. M. CURRIE

International Meehanite Metal Company, Limited,
66, Victoria Street,
London, S.W.1.
December 15, 1952.

THE ADVERTISEMENT for the Coleman Wallwork Company, Limited, in our issue of December 11 gave the telegraphic address as "Acknight Souwest." This should read "Acknight Southkens."

CINDERS raked from a rosin boiler are believed to have started a fire which burned out the coppersmiths' shop and swept along 90 ft. of the roof of the metal foundry of Geo. Robertson & Sons, Limited, Glasgow, recently.

THE MINISTER OF SUPPLY is to make a statement before Christmas defining the Government's attitude towards the criticisms of a number of members as to the position of the ironfounders under the provisions of the Iron and Steel Bill. Investment plans by ironfounders totalling less than £250,000 are to be excluded from control.

Grain-refinement and its Effects in Non-ferrous Casting Alloys*

By A. Cibula, M.A., A.I.M.

(*Communication from the British Non-Ferrous Metals Research Association*)

The first part of this Paper describes the influence of grain-size on the casting properties and mechanical properties of non-ferrous casting alloys; it is shown that feeding and resistance to hot-tearing during solidification may be improved by grain-refinement and that the mechanical properties, pressure tightness and speed of response to solution heat-treatment of the casting may also be greatly increased. The mechanism of grain-refining processes is then briefly discussed and reasons are suggested for the apparently inconsistent results which are sometimes obtained. The identities and the properties of solidification nuclei in some fine-grained alloys are also considered. Finally, recent developments in the refinement of aluminium- and copper-base alloys are indicated. The Paper contains references to much research work already well established but which is now gathered together for the practical foundrymen in logical sequence and given appropriate emphasis in the overall scheme.

Introduction

It is not always realized that the best properties can be obtained from many casting alloys only if the grain-size is carefully controlled. In particular, the feeding properties of a casting alloy may be much improved and its hot-tearing tendencies reduced by means of a grain-refining process, and the mechanical properties and pressure-tightness of the resulting casting are often greatly increased. Some examples of these and other effects of grain-refinement are described in the first part of this Paper.

Even when a method of grain-refinement is employed, however, it may produce inconsistent results, owing to incorrect conditions during the refining process or to a subsequent treatment of the melt which results in grain coarsening. In order to explain these apparent inconsistencies in the refining process, some of the theories of the mechanism of grain-refinement which have been put forward are discussed in the second part of this Paper. Finally, some recent work on the refinement of aluminium- and copper-base alloys which has arisen from these theories is briefly described.

Partly owing to the absence, at present, of a method of grain-refinement of more than limited application to copper-base alloys, most of the information on grain-refinement and its effects has been obtained from work on light alloys. However, this information does indicate the possibilities of developing a method of refinement suitable for cast copper alloys and the advantages likely to be obtained with it.

The term " grain-refinement " in the following account refers to changes in the *macrostructure* of a casting, not to the refinement of the *microstructure* such as that produced by the modification of the aluminium/silicon eutectic. Moreover, most of the alloys discussed below are those with mainly solid-solution structures (these include the great majority of commercial non-ferrous casting alloys); the macrostructures of completely eutectic alloys are not considered.

EFFECTS OF GRAIN-REFINEMENT

Direct Grain-size Effects

The first grain-size effect which should be considered is the inherent or direct effect—that due simply to the presence of grain boundaries and the change in the orientation of the crystal lattice from one grain to its neighbours[1]. Whereas an isolated metallic crystal can change its shape quite freely under stress, each grain in a polycrystalline specimen can be deformed only in such a way that its change of shape matches that of its neighbours, if the grain boundaries are strong enough to resist fracture; this requires the simultaneous operation of several sets of slip-planes or other modes of deformation, and, as these are always limited in number, a polycrystalline specimen is usually less easily deformed

FIG. 1.—*Plan (top) and Side View (bottom) of Transition Zone between Single Crystal and Polycrystalline Halves of Zinc Specimen, after Extension.* (*Miller.*) × 4.

* Paper (B.N.F.M.R.A. Misc. Pubn. 437) read before the Birmingham and Slough branches of the Institute of British Foundrymen. The Author is research investigator, British Non-Ferrous Metals Research Association.

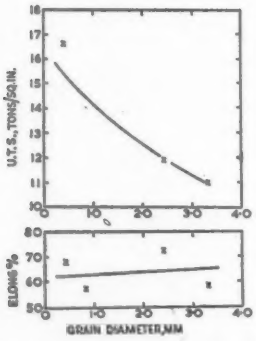

FIG. 2.—*Effect of Grain-size on Tensile Properties of Cast Cu/30 per cent. Zn Alloy.* (*Northcott.*)

than a single crystal of the same metal. This effect is illustrated in Fig. 1 (taken from a Paper by Miller[2]) which shows the change in shape under tension of an initially cylindrical specimen of pure zinc, the left-hand half of which was a single crystal while the other half was polycrystalline: although most of the single crystal was greatly extended, its free surface being broken by steps formed at the intersection with slip-planes, no appreciable deformation occurred in the polycrystalline half of the specimen or in that sector of the single crystal which adjoined the grain boundary.

The influence of the grain boundaries on tensile properties becomes more marked as the grain-size is reduced, but differs in the cubic and the hexagonal metals. This is shown most clearly in the wrought alloys, from which other, indirect grain-size effects which are observed in castings are usually absent.

In the wrought cubic metals, such as aluminium- and most copper-base alloys, a reduction in grain-size produces an increase in yield stress and U.T.S. and a decrease in elongation[3, 4]; these effects are smaller than those observed in the hexagonal metals, owing to the more numerous sets of slip and twinning planes in each grain of a cubic metal. In *cast* aluminium alloys, the inherent effect of the grain-size seems to be much less important[3, 4] than its influence on weak grain-boundary constituents (described below); this is confirmed by the fact that the grain-refinement of cast aluminium alloys (unlike wrought alloys) produces a large increase in elongation. In copper-base alloys the direct grain-size effect is more marked, but its importance in castings is not clear. Although Corson[5] found that the tensile properties of cast high-purity copper are independent of grain-size if gas-porosity is absent, Northcott[4] observed that a reduction in grain-size produced a marked increase in U.T.S. and a decrease in elongation of several cast copper alloys, which he ascribed to the inherent grain-size effect: for example, the U.T.S. of a 7 per cent. aluminium bronze was increased from 16 to 25 tons per sq. in.; Fig. 2 shows the change in tensile properties of a 30 per cent. zinc alloy studied by Northcott.

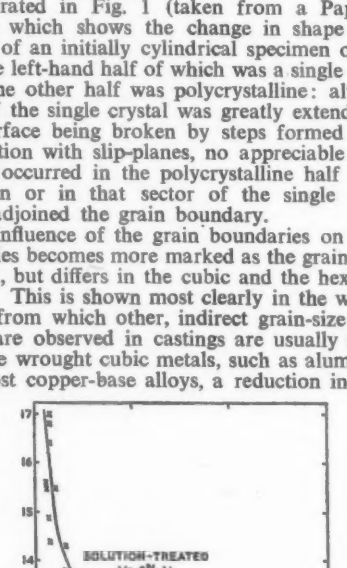

FIG. 3.—*Effect of Grain-size on U.T.S. of Solution-treated and As-cast Magnesium-aluminium Alloys.* (*Baker, Eborall and Lees.*)

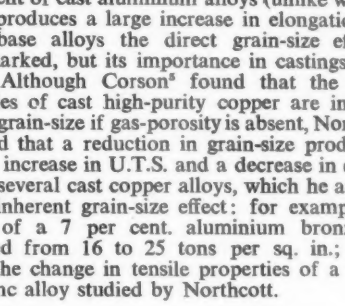

FIG. 4.—*Effect of Grain-size on U.T.S. of Solution-treated Magnesium/9 per cent. Aluminium/2 per cent. Zinc Alloys.* (*Burns.*)

The influence of the grain boundary is particularly marked in the polycrystalline hexagonal metals, such as magnesium and zinc and their alloys, each grain of which has generally only one set of slip-planes at room-temperature; in coarse-grained specimens of these metals the result is pronounced brittleness, owing to the premature cleavage of grains which are unfavourably orientated for deformation[7, 8] However, both the tensile strength and the elongation are greatly increased by grain-refinement; this improvement is presumably due to the reduction in size and the more uniform distribution of the premature cleavage fractures in a fine-grained alloy, or to the greater opportunity for rotation of grains which, initially, are unfavourably orientated.

The improvement produced by the grain-refinement of cast magnesium/aluminium alloys, illustrated in Figs. 3[9] and 4[10], is probably due mainly to this direct grain-size effect. As shown in Fig. 3, the improvement is greatest in the solution heat-treated alloys; in the as-cast alloys of high aluminium content it is largely masked by the presence of large quantities of a brittle intermetallic compound. The excellent mechanical properties of

the magnesium-zirconium alloys have also been attributed to the very small grain-sizes of these alloys [11].

The grain-refinement of magnesium alloy rolling slabs has been described as probably the most important factor in the improvement of their hot-working properties [6]. Cast slabs of pure zinc are normally very coarse-grained and can be cold-rolled only after the grain-size has been reduced by hot-working and recrystallization [12].

Indirect Grain-size Effects

The remaining grain-size effects are indirect, arising from the influence of the grain-size on the distribution of several weak constituents which occur at the grain boundaries in castings.

The distribution of residual liquid.—Of these constituents, the first to be considered is the low-melting-point residual liquid present during the solidification of the casting; the influence of the grain-size on the distribution of this liquid has important effects on feeding and hot-tearing properties.

It has been shown that the early stage of feeding in a casting of an alloy which solidifies in a pasty manner consists in the mass movement of liquid metal and solid dendrites together [13]. Eventually, the dendrites grow large enough to interlock and form a fairly coherent network, and subsequent feeding occurs by the passage of liquid metal between the dendrite arms; this is a slower process than mass-feeding (as the first stage has been termed) and becomes increasingly difficult as the dendrite arms thicken. The small dendrites of a fine-grained casting form a coherent network at a later stage of solidification and mass feeding is thus prolonged; consequently, fine-grained castings can be made less porous. This is shown in Fig. 5, in which are plotted the percentages of voids in D.T.D. test-bars of an aluminium/4.8 per cent. copper alloy, poured from degassed melts [14]. Baker [15] has shown that the dispersed shrinkage porosity in modified aluminium-silicon alloys can also be minimized by refinement of the primary solid-solution dendrites (*i.e.*, in addition to the normal modification process).

If the cooling-contraction of the semi-coherent network of dendrites is resisted, owing to the shape of the mould, hot-tears may result in the later stages of solidification. For this reason, as Lees [16] and the Birmingham University workers [17, 18] have shown, hot-tearing is partly a function of the temperature range in which the network of dendrites exists together with intercrystalline films of liquid metal; as this temperature range is smaller, for a given composition, in fine-grained castings than in coarse-grained castings, the former are less prone to hot-tearing. Pumphrey and Lyons [18] have studied this effect by pouring series of ring-castings in aluminium-silicon alloys, each series at a different casting temperature; the reduction in the severity of cracking as the casting temperature was lowered (Fig. 6) was associated with a refinement from a columnar to an equiaxial macrostructure and a corresponding change in the distribution of the residual liquid during freezing. The reduction in grain-size obtained in this way was not very

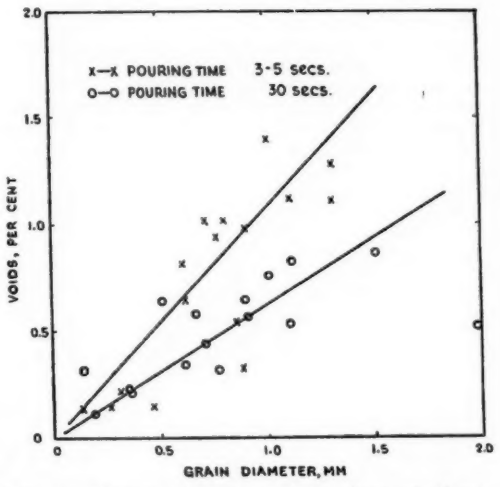

FIG. 5.—*Effect of Grain-size on Soundness of Aluminium/4.8 per cent. Copper-alloy Test-bars poured from Degassed Melts.* (*Mincher.*)

great; Lees [16] used titanium additions to an Al/5.5 per cent. Mg alloy to obtain a finer grain-size (of the order of 0.1 mm.) and showed that whereas the fine-grained alloy did not tear in the test-casting used, the coarse-grained untreated alloy (with a grain size of 0.5 mm.) cracked badly. Similar results have been obtained with castings in L.M.4 [19] and other aluminium alloys [20], and with magnesium alloys [13].

Payne [21] has shown that the refinement of a columnar to a fine-grained equiaxial structure in magnesium-aluminium alloys may also reduce inverse segregation, by breaking up the channels through which residual liquid can flow to the surface of the casting. This effect has not been observed in other alloys [22, 23] in which it has been studied.

Intermetallic compounds.—When the residual liquid solidifies, it may leave a brittle intermetallic compound which has to be dissolved by heat-

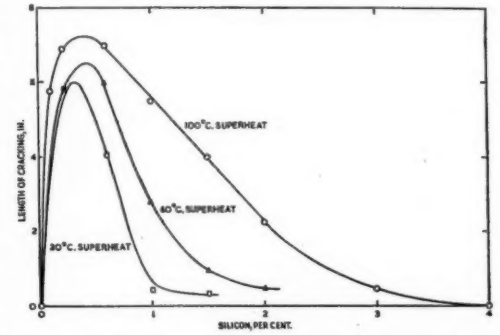

FIG. 6.—*Influence of Pouring Temperature and Grain-size on the Hot-tearing of Ring Castings in Aluminium-silicon Alloys.* (*Pumphrey and Lyons.*)

treatment to obtain the highest mechanical properties in the casting. In some alloys this constituent is observed largely at the grain-boundaries and, in such cases, by distributing the intermetallic compound more uniformly and in smaller patches, grain-refinement may reduce the times required for complete solution-treatment. For example, Partridge [24] has pointed out that the complete solution-treatment of coarse-grained magnesium/aluminium alloys is too prolonged to be economic, but is much more rapid in fine-grained castings.

Porosity.—The shape and distribution of shrinkage and gas voids may also be greatly modified by grain-refinement; the individual cavities in fine-grained alloys are small and isolated, whereas in coarse-grained castings they are larger and elongated along the grain boundaries, so that they tend to link up. Examples of this effect in castings of an aluminium/4.8 per cent. copper alloy are shown in Figs. 7 and 8 [25]. The harmful nature of the cavities shown in the latter figure is evident and suggests that the modification of shrinkage and gas porosity is probably the main reason for the very marked influence of grain-size on the strength and ductility of this alloy, illustrated in Fig. 9 [25]. The porosity and tensile properties of another heat-treated alloy, aluminium/10 per cent. magnesium, are similarly affected [26].

As in magnesium-base alloys, the beneficial effects of grain-refinement are largely masked in the as-cast alloys by brittle intermetallic compounds, and the improvement in tensile properties is therefore most marked in the high-strength, heat-treated alloys.

Large percentages of gas- or shrinkage-porosity are also deleterious, but comparison of the properties of coarse- and fine-grained alloys of varying soundness shows that the total amount of porosity is generally less important than the shape and size of the individual voids [14, 25]. Nevertheless, microporosity can be exceedingly harmful, even when the grain-size is small, in those alloys in which the voids tend to concentrate in shallow layers. Such layer-porosity (illustrated in Fig. 10) has been observed particularly in the magnesium/aluminium alloys, both magnesium-[13] and aluminium-rich,[27, 28] and seems to be due to internal hot-tears formed in the final stage of feeding, which are inadequately healed by the flow of residual liquid; the layer-porosity in a fine-grained alloy is similar in its effects to the large, intergranular voids in a coarse-grained alloy.

Constituents Formed by Impurities.—The most harmful constituents formed by impurity-elements are those which separate from the liquid metal at a late stage of solidification and consequently form near the grain boundaries in semi-continuous layers; they are particularly objectionable in the heat-treatable alloys as they usually cannot be removed by solution-treatment and therefore retain their harmful effects. For example, Parker and his colleagues[27] showed that in aluminium/10 per cent. magnesium alloys the iron-rich constituent ($FeAl_3$) is relatively harmless because it occurs randomly distributed throughout the grains, whereas the silicon-rich constituent (Mg_2Si) is much more harmful because it is situated at the grain boundaries, as shown in Fig. 11. Bismuth forms similar harmful intercrystalline films in copper-base alloys. The deleterious effect of these grain-boundary impurities may be much reduced by the increase in grain boundary area resulting from grain-refinement.

Conclusions

To summarize these effects, grain-refinement produces the most useful results in minimizing hot-tearing, and in improving the tensile properties of magnesium-, aluminium- and copper-base alloy castings when large amounts of brittle intermetallic

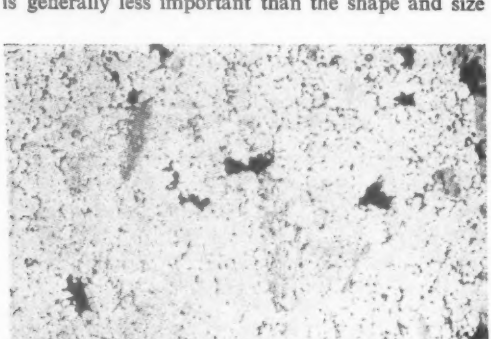

FIG. 7.—*Porosity in Fine-grained Test-bar of Aluminium/4.8 per cent. Copper Alloy.* × 20.

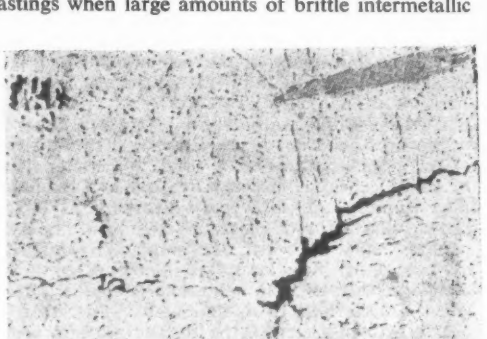

FIG. 8.—*Porosity in Coarse-grained Test-bar of Aluminium/4.8 per cent. Copper Alloy.* × 20.

compounds or porosity are absent, for example, in solution-treated alloys. Other useful effects which may be obtained are the reduction in solution-treatment times, the more uniform distribution of porosity, which should also improve pressure-tightness, and the counteraction of the effects of brittle intergranular films due to impurities. It should be remembered that many of these beneficial effects may be obtainable in fusion welds which suffer from several defects common in cast alloys.

GRAIN-REFINING PROCESSES AND GRAIN-COARSENING

The addition of any alloying element to a pure metal will usually refine the columnar structure of a sand-casting to some extent, but, in the absence of a specific grain-refining element, the finest grain sizes are produced only when very low casting temperatures are used (less than 40 deg. C. superheat with aluminium or magnesium alloys and less than 60 deg. C. superheat with copper-base alloys, the required temperature decreasing with increase in the size of the casting and decrease in the rate of cooling). This method of refinement, although applicable to any alloy, is obviously of limited use as the choice of the pouring temperature is usually controlled by other considerations.

When normal casting temperatures are used, a grain-refining element must be added to the melt before pouring—for example, titanium, niobium or boron to aluminium alloys, zirconium or carbon to magnesium alloys and iron to copper-base alloys. It seems fairly certain that the function of the grain-refiner is to form nuclei in the melt, usually a compound of the added element, on which dendrites of the solid metal can form more easily than in the absence of the nuclei; this is indicated by the fact that a pure metal or alloy, free from grain-refining elements, undercools several degrees below the true melting point before the first crystallites of solid can form, whereas in the presence of a grain-refiner undercooling before solidification is

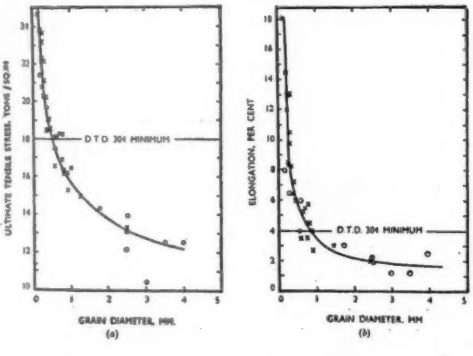

FIG. 9.—*Variation of (a) U.T.S. and (b) Elongation with Grain-size of Test-bars in Aluminium-4.8 per cent. Copper Alloy.*

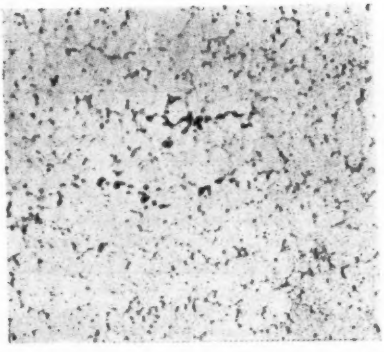

FIG. 10.—*Layer-porosity due to Gas in an Aluminium/11 per cent. Magnesium Alloy.* × 25.

much reduced and may even not be detectable. This effect has been observed in pure iron,[44] in magnesium/aluminium alloys refined by superheating,[28 29], in copper-base alloys,[40] and in aluminium-base alloys,[30 31] as illustrated by Figs. 12 and 13.[30] In the high-purity aluminium castings, marked undercooling occurred at the tips of thermocouples placed near the mould-metal interface (Fig. 12), though none was observed in the interior of the casting; after the addition of as little as 0.01 per cent. titanium no undercooling was detected at any position in the casting (Fig. 13).

Grain-size measurements show, however, that the maximum refinement produced by the introduction of nuclei is obtained only when at least a small concentration of an alloying element is also present in solution in the melt.[30] This effect is shown in Figs. 15 to 17; although the absence of undercooling showed that nuclei were present in both alloys containing 0.01 per cent. titanium, small equiaxial grains were obtained only when 0.5 per cent. copper was also added; in the absence of titanium,

FIG. 11.—*Undissolved Silicon-rich Constituent (script) and Grain-boundaries of Solution-treated Al/10 per cent. Mg Alloy containing 0.5 per cent. Si. Transgranular plates of $FeAl_3$ are also shown. (Parker, Cox and Turner.)* × 150.

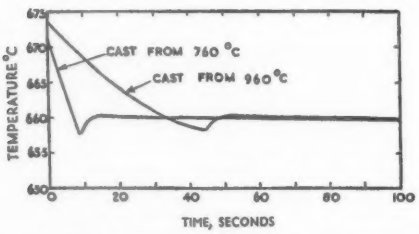

FIG. 12.—*Undercooling at Metal-mould Interface of Castings in High-purity Aluminium.*

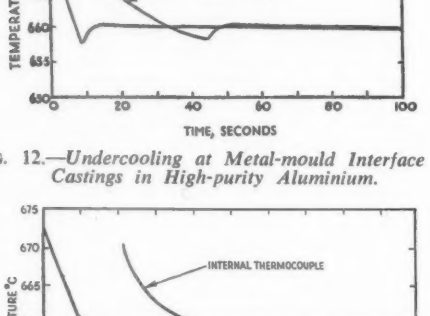

FIG. 13.—*Cooling Curves showing Absence of Undercooling at Surface and Interior of Aluminium/0.01 per cent. Titanium-alloy Casting, poured at 100 deg. C. Superheat.*

FIG. 14.—*Undercooling at Metal-mould Interface and Interior of Aluminium-8 per cent. Copper-alloy Casting, poured at 100 deg. C. Superheat.*

the same addition of copper had little effect on the grain size.

The effect of the dissolved element of increasing the refinement produced by added nuclei seems to be quite general[11, 46] and can be explained, as in the following example, by the presence of concentration gradients round growing dendrites, which have been postulated by many workers.[32, 33, 34]

As was shown above, castings in pure aluminium undercool considerably near the mould wall, but once the first crystals have formed in the undercooled liquid they grow rapidly, so that the temperature quickly rises to the melting point again, as shown in Fig. 12. The crystals formed at the surface then grow unimpeded into the interior of the casting and produce a columnar structure (Fig. 15), no further undercooling occurring. When an element such as copper is dissolved in the high-purity aluminium, the solid dendrites formed in the melt have a composition different from that of the liquid and are surrounded by a layer of liquid enriched in copper and of lower melting point. This concentration and melting-point barrier may be incompletely dissipated by diffusion at normal rates of solidification and may therefore impede the growth of the first crystals, thus retarding the release of latent heat; if sufficient copper is added, the liberation of heat is so hindered that it lags behind the abstraction of heat by the mould and the liquid metal remains undercooled, allowing undercooling also to spread into the interior of the casting and cause new, equiaxial crystallites to form there, as shown in Figs. 14 and 18.

The mode of solidification correspondingly changes from skin formation in pure aluminium to pasty solidification in aluminium-copper alloys, as demonstrated by Ruddle.[35, 36]

In this way, the addition of a soluble alloying element to a pure metal may refine a columnar to a coarse equiaxial structure by reducing the rate of growth of individual crystals. If nuclei are also present, the formation of new crystals occurs with much less undercooling, as shown previously, and the number of grains formed is therefore very much greater, so that the finest grain-sizes are obtained even with quite small percentages of alloying elements. On the other hand, if nuclei alone are present in pure aluminium, only the formation of grains at the surface of the casting is helped by the nuclei and these grains, though more numerous, grow into the casting unimpeded by concentration gradients, resulting in a narrow columnar structure (Fig. 16).

The use of a low casting temperature instead of a grain-refining element produces very similar effects owing to the formation of particles of solid metal in the pouring stream, which act as nuclei in the same way as foreign nuclei introduced with a grain-refiner[32, 37].

To summarize, maximum grain-refinement depends on two factors: (1) the presence of nuclei introduced with the refining element, which facilitate the *formation* of crystallites, and (2) the presence of concentration gradients due to alloying elements dissolved in the melt, which impede crystal *growth*.

Grain-size Effects due to Presence of Nuclei

The presence of nuclei in melts is responsible for many grain-size effects familiar to the foundryman, of which the following are examples. An excessive superheat leads to solution of the nuclei in aluminium-alloy melts with consequent grain-coarsening and a rapid fall in tensile properties, as shown in Fig. 19.[25] The grain-coarsening persists even when the melt is allowed to cool again after superheating and is only eliminated by holding and casting at a low temperature or by solidifying and remelting, either of which treatments may lead to reprecipitation of nuclei[30, 31].

Holding the melt for long periods at a low temperature may lead to gravity segregation of the nuclei, with the result that only the metal poured from the bottom of the crucible is fine grained. For example, castings poured from magnesium/aluminium melts allowed to stand for 30 mins. or longer at 700 deg. C. are coarse-grained[9, 38].

Finally, the passage of gas bubbles through an

aluminium-alloy melt will often remove nuclei and produce grain-coarsening, though this does not occur when chlorine or hexachlorethane are used and is only serious, at normal casting temperatures, when the time of bubbling used is longer than that necessary for degassing. The percentage of the titanium which is lost when the nuclei are removed in this way is less than 10 per cent., indicating that the greater part of the titanium is in solution and is not effective in producing grain-refinement. Many batches of aluminium-alloy ingot are coarse-grained because the titanium content, though high, is not present in the form of nuclei; this is particularly true of many secondary alloys, presumably because of flux-treatments and repeated remelting before the ingots are finally poured[25, 39].

Identification of Nuclei

Several methods have been used to identify the nuclei in fine-grained alloys. For example, the nuclei in aluminium alloys containing titanium have been isolated by centrifuging the particles from molten alloys which consequently became coarse-grained when solid, as shown by comparison of Figs. 22*a* and *b*. The segregated nuclei (shown in Fig. 21) in the surface of the solid specimen were then identified as titanium-carbide crystals by glancing angle X-ray examination; the amount of segregated carbide represented only 1 to 10 per cent. of the titanium in the alloy, in agreement with the estimate given above.

In recent work at the B.N.F.M.R.A.,[40] it has been found that when magnesium/aluminium alloys are superheated in pure aluminium crucibles, using only high-purity fluxes and metals, grain-refinement does not occur unless carbon is added to the flux. This confirms previous suggestions[41] that the nuclei in fine-grained commercial magnesium/aluminium alloys refined by super-heating may be the same as those formed in the alternative method based on the addition of carbon, and that, as both methods are fully effective only in alloys containing aluminium, the nuclei may be particles of aluminium carbide.

Other examples of the identification of nuclei are described in the literature [30, 39]; with this knowledge it may sometimes be possible to find ways of increasing the effectiveness of the grain-refining addition, as discussed below.

Properties of Compounds Forming Nuclei

In order to develop new methods of grain-refinement, suitable, for example, for copper-base alloys, it is desirable to determine the properties which enable particles of the nucleating compound to act as nuclei, for the evidence suggests that only a few, specific compounds are suitable. Consideration of the nucleating compounds which are known at present, in metallic and in non-metallic melts or solutions [42] indicates that the following properties are required:—(i) sufficient stability to exist in the melt at high temperatures without decomposition; (ii) a melting point above the melting point of the alloy; (iii) a structure which is (*a*) similar in type and dimensions to that of the metal to be nucleated and (*b*) forms strong adsorption bonds with atoms of the metal.

For example, the titanium carbide nuclei in aluminium-alloy melts have a high stability and melting point, and a structure which is similar to that of aluminium, both solids having face-centred cubic structures with dimensions which differ by only 6 or

FIG. 15.—*Section of High-purity Aluminium Casting poured* 100 *deg. C. Superheat.* × ½.

FIG. 16.—*Section of Al*/0.01 *per cent. Ti*/*alloy Casting poured at* 100 *deg. C. Superheat.* × ½.

FIG. 17.—*Al*/0.5 *per cent. Cu*/0.01 *per cent. Ti*/*alloy Casting poured at* 100 *deg. C. Superheat.* × ½.

FIG. 18.—*Section of Al*/4 *per cent. Cu*/*alloy Casting poured at* 100 *deg. C. Superheat.* × ½.

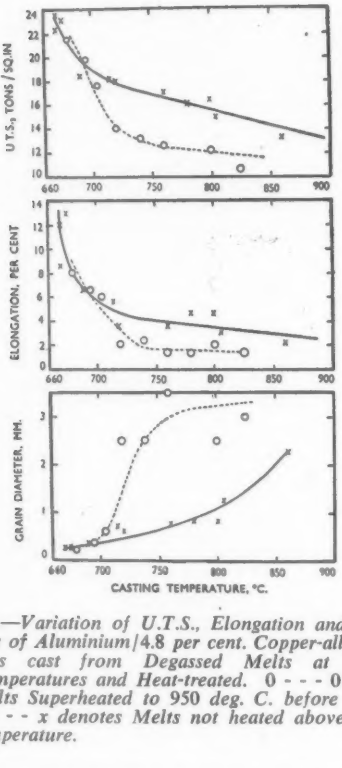

FIG. 19.—*Variation of U.T.S., Elongation and Grain-size of Aluminium/4.8 per cent. Copper-alloy Test-bars cast from Degassed Melts at various Temperatures and Heat-treated.* 0 - - - 0 *denotes Melts Superheated to 950 deg. C. before casting;* x - - - x *denotes Melts not heated above casting temperature.*

7 per cent. In addition to these properties there are others which may be desirable, such as a similarity of the densities of the compound and the liquid metal, which prevents the nuclei from segregating in the melt.

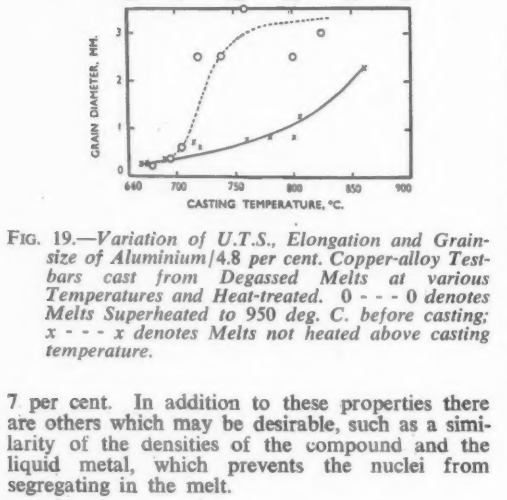

FIG. 21.—*Particles at Bottom Surface of Centrifuged Aluminium/0.1 per cent. Titanium specimen.* × 2,000.

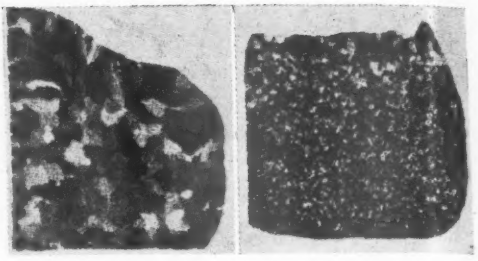

FIG. 20.—(*a*) *Coarse Grain-size in Aluminium/0.1 per cent. Titanium Alloy centrifuged at 690 deg. C.* × 3. (*b*) *Fine Grain-size in specimen heated at 690 deg. C. in stationary centrifuge.* × 3.

RECENT DEVELOPMENTS

In recent work at the B.N.F.M.R.A. it has been found possible greatly to increase the effectiveness of several known grain-refining elements in aluminium alloys, particularly titanium. An improved refinement produced by simultaneous additions of titanium and boron was first pointed out to the association by Dr. Strauss [43]; it has now been shown [39] that the explanation of this effect is that suitable concentrations of titanium and boron convert practically all the titanium into titanium boride crystals which, like titanium carbide particles, act as nuclei; as a result, grain refinement may be produced by only 10 per cent. of the usual titanium addition and fine grain sizes may be obtained even with very high casting temperatures, as shown in Fig. 22. It is important to avoid excessive amounts of titanium boride as the crystals tend to segregate in the melt on standing and produce hard spots. Further details are described elsewhere [40].

In current work at the B.N.F.M.R.A. the theories described above are being applied to the grain-refinement of copper-base alloys, to develop a process less limited in application than the addition

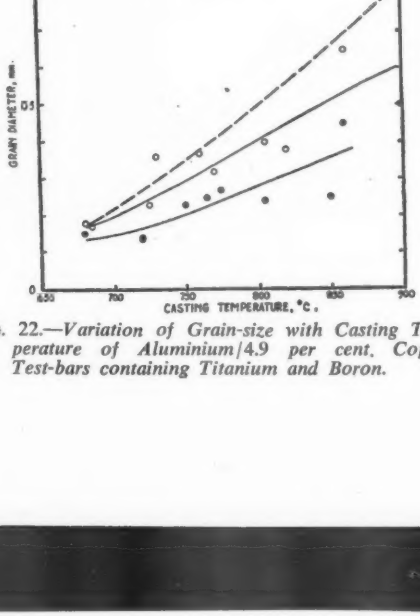

FIG. 22.—*Variation of Grain-size with Casting Temperature of Aluminium/4.9 per cent. Copper Test-bars containing Titanium and Boron.*

of iron. As much as 1 or 2 per cent. is required to produce marked refinement and, although the resulting grain-size is very fine (about 0.1 to 0.2 m.m.) and not too greatly affected by the section-thickness of the casting, these high concentrations are sufficient to produce thick oxide films on the pouring stream of bronzes and gunmetals, which interfere seriously with the excellent casting properties of the alloys. For this reason, iron additions are used in practice only for the refinement of aluminium brasses and bronzes, on which alumina films are formed even in the absence of iron and for which special running methods are therefore used. The refinement produced by iron additions seems to be due to nucleation by particles of iron or an iron-rich compound. Attemps are therefore being made to find alternative nucleating substances which can easily be introduced into melts and do not result in the formation of harmful oxides; additions of several compounds which are being studied have produced marked refinement and the results so far obtained are in agreement with the theories described above.

The Author is indebted to the director and Council of the British Non-Ferrous Metals Research Association for permission to publish this Paper.

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New Catalogues

Refractories. A leaflet received from General Refractories, Limited, Genefax House, Sheffield, 10, details a range of "Sillmax" bricks which are designed mainly for high-temperature use in oil-fired furnaces. As they are not recommended for applications where contact is made with ferruginous slags, cupola applications can be ruled out.

Furnace Service. A publication issued by Sklenar Furnaces, Limited, of Colchester Avenue, Cardiff, is not really a catalogue, but an after-sales-service publication. Instructions are detailed by numbered paragraphs and by clear illustrations for the relinings which they supply. Obviously this leaflet is only of use to those using Sklenar furnaces; it may be obtained on writing to Cardiff.

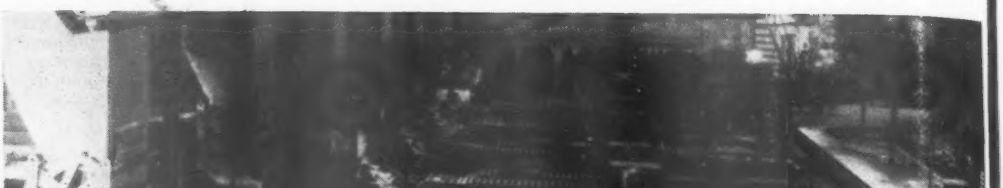
Fireproof Cables. British Insulated Callender's Cables Limited, Norfolk House. Norfolk Street, London. W.C.2, have just issued a particularly interesting catalogue running to 28 pages carrying exclusive data on asbestos-covered cables. Such cables are especially useful for lighting and power wiring in foundries, where the fire hazard is present. No fewer than seven tables are needed to set out the characteristics of the types included in this range. Copies are available to our readers on application to Norfolk House.

X-ray Accessories. From Solus-Schall, Limited, of 18, New Cavendish Street, London, W.1, has been received a 52-page catalogue describing and illustrating a particularly wide range of apparatus required for X-ray investigations. A good feature of the brochure is the inclusion of a complete index of the contents. Foundry concerns possessing an X-ray department, or envisaging installing one, should certainly see that they are in possession of this useful booklet. It is available to readers on writing to New Cavendish Street.

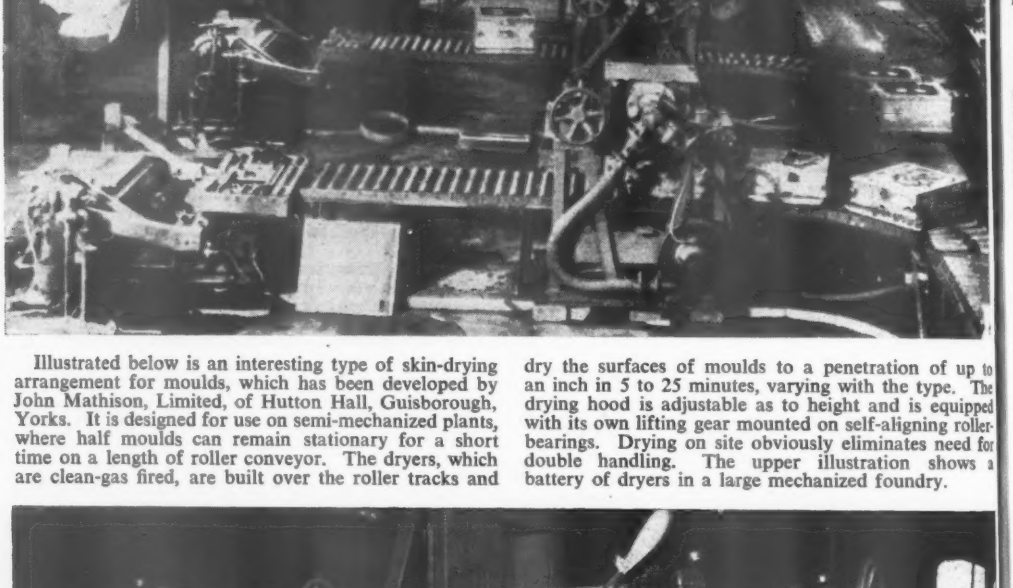
Paddle Wheel Type Fans. As the foundry industry is thinking a great deal about dust and fume reduction, a catalogue bearing the above caption, issued by Keith Blackman, Limited, Mill Mead Road, London, N.17, is of considerable interest. Especially useful are the capacity tables giving data of fans ranging from 500 to 30,000 cub. ft. per min. Additionally some illustrated details are included of wet- and dry-type unit dust-collecting apparatus, but for these special catalogues are available. The catalogue is nicely presented in an olive-green cover, a colour used throughout. It is available to our readers by writing to Mill Mead Road.

Elevator Buckets. A leaflet just issued by Foundry Equipment Limited, Leighton Buzzard, Bedfordshire, describes and illustrates an ingenious mechanical contraption for ensuring the complete emptying of the elevator buckets when used for transporting sand. Because of stickiness this has often caused considerable annoyance. Experiments have been made in the direction of providing the smoothest possible surfaces. Now the problem has been tackled mechanically. This has been effected by mounting in each bucket hinged stripper plate, which when on the upward fits snugly forming a lining, but on turning over at the top position, the apron comes forward, and so scrapes the bucket clean from adhering sand. The leaflet describes and illustrates the sizes available, and is obtainable by our readers on writing to Leighton Buzzard.

Skin-drying of Moulds



Illustrated below is an interesting type of skin-drying arrangement for moulds, which has been developed by John Mathison, Limited, of Hutton Hall, Guisborough, Yorks. It is designed for use on semi-mechanized plants, where half moulds can remain stationary for a short time on a length of roller conveyor. The dryers, which are clean-gas fired, are built over the roller tracks and dry the surfaces of moulds to a penetration of up to an inch in 5 to 25 minutes, varying with the type. The drying hood is adjustable as to height and is equipped with its own lifting gear mounted on self-aligning roller-bearings. Drying on site obviously eliminates need for double handling. The upper illustration shows a battery of dryers in a large mechanized foundry.



External Dust Control for a Pedestal Grinder*

London Branch Discussion of the Paper by Mr. W. H. White, F.R.S.A., and Mr. W. B. Lawrie, M.Sc., F.R.M.S., A.I.M.

Following a brief review of the position and nature of the problem obtaining with regard to dust-collection from foundry grinding operations, a film was shown by the Authors which graphically illustrated the steps taken in the investigations they reported. Later, the meeting was opened for discussion, when mainly points of detail were dealt with, since it was clear that the further implications of the work required time for assimilation. The disrupting effect of the work rest, neutral zones, baffle plates to exclude extraneous air, obstruction to the working space and the recommended "safe" limits for dust concentration were among points raised.

Before showing the film, MR. LAWRIE said that the range of his remarks would be restricted to the subject in hand, and he would therefore be unable to show how it fitted into the overall picture of dust suppression. However, he hoped that it would be remembered that dust control was only one method and that successful dust suppression involved the whole range of foundry practice. A ventilating engineer should never be expected to remove dust which had been generated simply and solely by reason of bad foundry practice. Inevitably the question of cost would arise, and whatever was done to improve conditions in foundries must be contained within the financial framework which supported the industry. It was essential that they should ensure that the desired conditions were attained by methods which would not wreck the industry. This was one of the reasons why high-velocity, low-volume, air curtains had been used, because they extracted less heat from the building.

The Case Stated

For the benefit of those who had not seen the former film, it should be explained that eighteen months previously the Authors had wanted to see where and how the dust clouds moved in space. The clouds in which they were interested were those composed of particles with a size range of less than 10 microns. There were 1,000 microns to a millimetre and roughly 25,000 to the inch, and on grinding machines the airborne dust cloud would have a median size of about ¼-micron so that most of the dust particles were about 1 micron or 1/25,000 in. in diameter. The first film had shown that a wheel running at a peripheral velocity of 9,000 ft. per min. resulted in such a heavy fan effect that it delivered the dust outwards, in spite of the fact that the local ventilation system was endeavouring to take it in the opposite direction. A check was made on a much smaller wheel running at 5,000 ft. per min., and it was found that the phenomenon which appeared on the fast wheel was duplicated on the slower one, and that the local extraction system fitted to it was quite inadequate to control the dust thrown off from the wheel.

Having decided it was impossible to stop the dust from coming out, it had then also been decided that it was logical to let it come out, and try to pick it up afterwards where it was moving at a much slower speed. They had photographed the dust clouds which corresponded to the varying air velocities in the zone around the wheel, and that part of the work represented fundamental information on the method of dust generation.

Faulty Dust Collection

Standing beside the wheel which had been used, was a dust collector which was vented to the open air, so that dusty air would not be re-circulated in the laboratory, but unfortunately they had found a permanent and heavy leakage of dust from that collector. This resulted in a stream of over 2,000 particles per ml. constantly leaking away, and moving towards the operator. Many attempts had failed to repair the dust collector, which had been placed in such a fashion that it was under pressure from the fan. It was a matter into which ventilating engineers might well look as it seemed to be the wrong place to put the fan, because if a collector under pressure leaked, it would leak outwards, whereas if it was leaking under negative pressure it would take in clean air from the room.

Quite apart from the observation side of the work, dust counts had been taken with an Owens Jet counter, and also with a thermal precipitator. By using rusty sand-cast pig-iron, the Author had generated dust clouds up to and over 60,000 particles per ml., and in those conditions of gross over-load the highest dust count at the breathing level of the operator was less than 700 particles per ml. Most of the dust concentrations fell between 400 and 500 particles per ml., counting all particle sizes down to the limit of visibility under a 2-mm. oil immersion lens. In other words, this represented an efficiency by count, of over 99 per cent. on all sizes above about a quarter of a micron.

Another point of interest to those engaged in dust counting had emerged, because it was found that the dust streams were very clearly defined, and if one moved the sampling instrument by so much as an inch, in certain cases, a very different result was obtained. It seemed, therefore, that

* Paper printed in the JOURNAL, December 4 and 11, 1952.

thermal precipitator counts should be taken in conditions where the dust streams could be seen, and not in ordinary conditions of lighting where the dust was quite invisible.

The Authors did not suppose that they had found the full or final answer to the problem which they had tried to solve, but they had published their early work in an effort to awaken interest.

DISCUSSION

MR. MCVITTIE (Research & Development Division, British Steel Founders' Association) said he had noticed that some work was not done on a work rest but was mainly suspended work which used a much larger area of the wheel circumference and would seem to exclude any use of a hopper in front of the wheel because the work extended below. Was there any prospect of the system being extended to apply to that kind of work?

MR. W. H. WHITE, in reply, said that as the dust was generated at the point of contact with the wheel, and the primary air stream became dust laden, the diversion of this air stream would depend on the shape and position of the casting. If the casting was suspended in a vertical position, a large portion of this air stream would come within the collecting zone of the top nozzles, and the vertical exhaust arms would collect the side diffusion of the primary air stream.

MR. W. B. LAWRIE, in addition, said he doubted Mr. McVittie's statement that most wheels were used on work which was suspended. He believed, in fact, that most wheels had a rest. He stressed the fact that they were describing new work which had not been extended to include grinders at which the work was suspended, and he could not therefore give Mr. McVittie anything like a full answer without further experimental work. He pointed out, however, that the primary stream was stripped from the wheel by the work itself and so was diverted upwards towards the exhaust nozzles. He thought, therefore, that even suspended work might act as a stripper and divert the dust from wheels which were not fitted with a rest. The only way to get the complete answer to this question was to experiment.

MR. C. KAIN asked whether any thought had been given to assisting the extraction with an external fan—putting pressure on from above—which seemed to be a logical development.

MR. W. B. LAWRIE said that the difficulty with air jets was the fact that they tended to dissipate the dust in the atmosphere. The object of the work had been to collect the dust, using the velocity in the air stream itself.

Velocity of Dust Stream

MR. HART said he had noticed that when the stream left the rest horizontally it had a velocity of approximately 1,250 ft. per min.; it then struck the operator at 800 ft. per min., rose vertically and increased in velocity to 850, and then decreased to 750, and he would like to know whether that was correct and it did in fact increase for a period and then decrease.

MR. W. B. LAWRIE replied that in the case in question there was an acceleration, although he could not explain it fully. He imagined it was probably due to air currents joining with the main stream, having come from the rest at an acute angle and with a velocity greater than that of the main stream. This illustrated the fact that they needed a good deal more fundamental information, and he would like the ventilating engineers to think about it. It would also be a good thing if they could have a mathematical analysis of the dust movements. The Authors had not yet considered this because they felt they ought to be controlling the dust, but there was no doubt that such an analysis would have to be made at some stage in the work.

MR. BERESFORD asked whether there was any reason why there should be two ducts instead of one; MR. W. H. WHITE replied that there was no reason at all, and it had been done merely because they had already divided the top duct into two for the V-arms; later, ducts had been made in one piece.

Alternative Positions

MR. BARNARD said he would like to know the distance of the work rest from the wheel. If that distance was increased a certain amount, the dust came round with the wheel and followed it right round again and was exhausted. Also, instead of having the ducts above the top of the cowl they might be taken from the top of the cowl so that the dust was removed from the inside of the cowl and was prevented from coming out altogether.

MR. W. H. WHITE, in reply, said they had not tried this, but it had been tried by others and it had been found that one would have to have such a velocity to overcome the surface air speed of the wheel right round its circumference that the fan and power would be uneconomical. With reference to opening the distance of the rest from the wheel, a somewhat similar effect could be achieved by either slotting or perforating the rest and allowing the primary stream to go through and expend itself in the collecting box.

MR. WIZARD asked whether the lecturers could give some idea of the air-turbulence at the breathing level of the operator and whether there was likely to be any harmful effect. He would like Mr. Lawrie to do some simple diagrammatic sketches to show what practical use he had made of the two neutral areas which he had found, and also to say whether the dust was at rest in that area.

MR. W. H. WHITE replied that on a 14 in. by 2½ in. wheel rotating at 1,400 r.p.m. with a peripheral velocity of 5,000 ft. per min., in the breathing zone there was an air movement of about 50 cub. ft. per min., taking the height of the average man. Though the air into the nozzles lost velocity very quickly, this air movement was about 70 ft. per min. at the breathing zone. The whole principle lay in having a high-velocity curtain, with

faster movement than the current diffused from the action of the wheel.

MR. W. B. LAWRIE, replying to the second part of the question, said it would be found that the primary stream came down the wheel face, along the work, up the man's body, and in the area between his face and the wheel top there were very low velocities (and in two cases no velocity). This was obviously the place to pick up the dust instead of trying to turn it back at the nose of the guard, which the conventional system did. These low velocities and neutral points had been utilized by placing the nozzles in such a position that the dust was collected from the zone in which they occurred.

Previous Work

DR. T. C. ANGUS (London School of Hygiene & Tropical Medicine, Department of Applied Physiology) referred to the work done by Hatch and Delavalle in the United States of America, who had dealt with machine cutters which worked over the surface of granite blocks and produced a quantity of dust of a silicious nature, and who had wanted to find the best way of collecting the dust in existing hoods. Hatch and Delavalle had found that if it was a plain rectangular hood or a plain open tube, the air would come in from the front, but it would also come in from behind round the corner, thus reducing the efficiency of the hood as a whole. More important still, Delavalle and Hatch, in their experiments, had shown that this influx of air from "dead" spaces reduced the pull of the hood at distances in front of it. They also showed the air velocity as one went away from the hood did not fall off proportionally as the distance but inversely as the square of the distance. It had been found that by putting a small flange round the outside, one could push the velocity contours around the hood forward considerably, and it had occurred to him that in the work which had been described an even greater improvement could have been made by putting a little flange on the collecting hood and another one at the bottom. Dr. Angus hoped that these remarks would not be taken as any disparagement of the Author's outstanding piece of work.

MR. W. B. LAWRIE agreed that they had not used that work, of which they knew, and they could almost certainly improve efficiency by using it. The primary interest, however, had been to catch the dust. At the moment, he was not very interested in the theoretical considerations of the pneumatic transport of the dust because he thought it could not be caught. Putting on a flange should result in a greater efficiency, but he doubted whether it would have solved the essential problem of capturing the main dust cloud.

MR. W. H. WHITE thanked Dr. Angus for his suggestion, adding that they had in fact now tried the arrangement with the top nozzles and had found they did not lose the velocity so quickly.

DR. J. G. PEARCE wished to congratulate both of the Authors on a remarkable piece of co-operative research. As had been seen, once the job was started they had used an improvised set-up with the wheel which was used for tool grinding in the machine shop, and the fans which had been available on the spot, but the results had seemed sufficient to justify presentation with a minimum of time lag, although it was quite obvious that the principle had to be tried on wheels of larger diameters and higher speeds, and that work was already in progress. It also had to be extended to cases such as had been mentioned—work that was suspended, the swing-frame grinder, and so on.

The device had been provisionally patented, in accordance with the policy of the Council of the British Cast Iron Research Association, to prevent it being patented against them and hence against their member firms, but having done that he felt sure that the Council would do everything in its power to encourage industry to adopt it. H.M. Factory Department might well have views on its adoption, but he felt quite sure that progressive employers would desire to do anything within their power to improve the conditions for men working on wheels of that type. Apart from that, there was a very definite inducement to adopt the system, because it was expected that the overall power consumption would be reduced, partly because of the smaller removal of heated air from the shop. The work seemed to him to be an outstanding example of the value of not assuming that a conventional and generally-accepted arrangement was necessarily sound.

MR. A. A. MATTHEWS said that as the user of a pedestal grinder he was naturally very interested in the subject, but he had noticed that the work was done on a 14 in. by 2½ in. wheel, with the take-away ducts at the side possibly set back 2 in., and he took it that they would be telescoped to allow for wear and tear on the wheel. Also, the work had been done on a straightforward piece of iron and he wondered what they would do with a casting with a flange either side, where the operator had to move sideways with it; in that case the ducts would obviously be hit and they would cease to operate.

MR. W. H. WHITE, in reply, said that in the experimental model the vertical ducts turned downwards were mounted in rings on hinged wing plates, so that it was possible to grind round the corner of the wheel and the duct would be pushed away by the casting. The duct wing plates swivelled on the end of the guard. There was no reason at all why these exhaust points should not be set back nearly to the wear-down mark of the wheel if their air velocities were increased in proportion.

Standards of Dust Reduction

DR. ANGUS asked whether there were at present available standards of maximum safe concentrations for the various dusts with the thermal precipitator. He knew that there were in America with the Greenburg-Smith impinger, but believed that in this country the only definite rulings were with regard to coal.

MR. W. B. LAWRIE replied that threshold limits were not used in this country because the medical profession considered that it was quite impossible

to fix the dust concentration below which no one would suffer injury to health. He understood that part of the reason for this was that individual susceptibility varied considerably. It was obviously desirable to live in an atmosphere which was as clean as possible, and efforts were being made to reduce dust concentrations to a minimum and not merely to get them to a figure at which the conditions might be supposed to be tolerable.

MR. D. MORRIS said it had appeared that the experiments were made in a still atmosphere, and, taking into account the conditions to be found in some foundries, he wondered whether an external draught would make a great difference.

MR. W. B. LAWRIE replied that he did not think it would. They had been trying to find out the dust movements in still air, and not the movements resulting from stray draught. Undoubtedly in due course they would conduct an experiment in a draughty room; in his opinion, it would need a fairly heavy draught to disturb the air curtains. MR. W. H. WHITE added that if the draught had a greater velocity than the air curtains, it would dominate.

Location of Dust Collecting Points

MR. A. R. PARKES said that the obvious place to collect dust would seem to be its point of generation, but it had been explained that this was more or less impossible because of the high velocity of the dust particles at this position. A second obvious place would seem to be the danger point where the dust was inhaled, where presumably there was very low velocity, so that the closer the collection point to the point of inhalation the better, disregarding for the moment the possibility of other people working in the vicinity. In that case, if one could have a shop in which there were no people other than grinders working, or even have the grinders working in cubicles, why could not the collection point or the provision of " fresh " air be made quite close to the nostrils or the mouth of the operator? There was a similarity with electric welding, for instance; in that process it was impossible to protect the whole shop and equally impossible to shield the arc at the point of generation, but the operator was made to wear a protective device.

In reply, MR. W. B. LAWRIE said, personally, he did not like cubicles. He thought they were cumbersome; they often had a very large superficial area; and it was then necessary to buy a large fan which was expensive and wasted a great deal of heat—and this often made it necessary to instal another heating system.

He did not see why they should take the dust closer to the nose of the operator. They were not, in fact, taking it away from his nose, but were trying to contain it near the point of origin; they had put air curtains along the sides and one over the top, and were trying to hold the dust in that box made up of moving air, and keep it as far as possible away from the nose of the operator. In the *reductio ad absurdum* case the other difficulty to be faced in collecting from the point of the operator's nose was that the position of this point varied considerably in time and space, and unfortunately to no well-known pattern!

Vote of Thanks

MR. COLIN GRESTY (Chairman, Foundry Atmospheres Committee), in proposing a vote of thanks to Mr. Lawrie and Mr. White, said they had accomplished a job of work very well and very quickly. He hoped the film which had been made would be taken up whole-heartedly, not only in the foundry industry, but also by the makers of foundry equipment.

Thanks were also due to all the other workers who had helped them; it had been teamwork at the British Cast Iron Research Association which had given members a most entertaining, interesting, and instructive evening.

In seconding the vote of thanks, MR. BARNARD said it was a subject upon which there could not be too much discussion, and the film which had just been shown would give them still more ideas as to how to tackle the problem of dust control.

Corrosion Resistance of Stainless Steels

Stainless steel differs from most corrosion-resistance materials in one respect—whereas Monel metal and copper exposed to dilute acid are corroded more quickly in presence of oxygen than in its absence, the converse is true of stainless steel. This explains occasional breakdowns of stainless steel plant in cases where oxygen has been removed accidentally or intentionally. Berwick and Evans (J. App. Chem., October, 1952), studying 18/8 stainless steel in 0.5 M. sulphuric acid, find that oxygen additions below a certain quantity fail to render it passive (*i.e.*, resistant to corrosion). When that quantity is exceeded, passivity is produced in a time which steadily becomes shorter as the oxygen addition is made larger. The simple quantitative relationship established between oxygen-addition and passivation time is explained by the formation of an invisible oxide film, thickening by the logarithmic law—the law generally obeyed by metals at ordinary temperatures. The fact that films on stainless steel are protective, whilst those on ordinary steel are not, can also be explained in this manner. This subject was discussed by Dr. U. R. Evans, who presented views that took into account the results of recent research in a paper, " The Corrosion Resistance of Stainless Steels," at a joint meeting of the Society of the Chemical Industry, with the Sheffield Metallurgical Association, in Sheffield last week.

Forty Years Ago

Our issue of December, 1912, contains an article on foundry education by the Editor, which is quite modern in outlook and makes as wonder still more why the previous month he printed some ridiculous mediæval views upon which we commented unfavourably last month. The appointment of officers for the then recently-founded British Engineers' Association is announced. Mr. Douglas Vickers was President, and mongst the vice-presidents were Sir Robert Hadfield and Sir John I. Thornycroft. Armstrong College course of metallurgy.

Notes from the Branches

London—East Anglian Section

At the inaugural meeting for the 1952-53 session of the East Anglian section of the London branch of the Institute of British Foundrymen in Ipswich, Mr. R. J. Hart was inducted into the chair by the retiring president, Mr. V. W. Child, who said he was pleased to welcome Mr. Hart as a well known and active member of the section, who had also presented several technical papers on behalf of the Institute. Mr. Child also emphasized the good work done by his Council during his year of office, especially by Mr. Ward, who arranged the annual dinner with great success. Mr. Child realized that the section was becoming more active each year, therefore the position of president was a more onerous duty, but he was sure that Mr. Hart would fulfil this rôle with the greatest dignity.

Presidential Address

Mr. Hart then delivered his Presidential Address, in the course of which he said that although East Anglia could not be classed among the highly industrialized areas of the country, it had produced some notable characters—it had also produced some very good foundrymen, many of whom had held high positions in the Institute. One in particular, the late Mr. W. B. Lake, eventually became its president. Furthermore, many of the members had presented papers to the Institute, and quite a number of Diplomas had been awarded to section members. These remarks were not made to give themselves "a pat on the back" but would, he hoped, be an inspiration to other younger members who must in due course take over the reins of administration.

During recent years more and more research and development institutions had been established to enable foundrymen to control their product. The work of these institutions had led to many improvements in such things as running and feeding techniques, sand and metallurgical standards, which, if applied in the correct way, *must* lead to better castings, and it was up to practical foundrymen to take advantage of these efforts of the research workers.

It should be borne in mind that there was a vast difference between foundry research work and its practical application, and there were times, perhaps, when the practical foundryman was disinclined to experiment with something which might appear to him to be of no practical use. Perhaps, older members were more guilty of this hesitancy than the younger generation and might be apt to condemn a new method without first exploring all its possibilities. It should be the natural ambition of the average man to do something better than was done in the past, whether this be an attempt to break speed records or produce a better sand casting, and facilities to enable him to achieve this latter ambition were to a large extent the results of research work.

Stress on Quality

It must be remembered that since the beginning of the second world war, a new generation had entered into industry, a generation, which was being told by all and sundry, and particularly politicians, that if they could only produce more and more articles, all their troubles would be at an end. This statement might or might not be true, but, unfortunately, the word "quality" did not appear too frequently. In this age of greater productivity, people were apt to overlook the importance of the word "quality"—a word, it must be remembered, which was always associated with a British product and in the long run would be one of the deciding sales-factors of all manufactured goods.

For any company or indeed any country to remain solvent and make progress, productivity *and quality* must go hand in hand, and the foundry industry—a progressive industry—must not be found lacking in this latter virtue. How often did one hear that such and such an article was not up to pre-war standard, and by standard was meant *quality*? To progress meant to go forward and to progress in industry there must be improvement *in quality* as well as quantity, if Britain was to remain a first-class industrial nation. Modern production methods did not often afford to present-day workmen the opportunity of completing an article, and their interest was usually directed to one particular operation. Although such methods were necessary to achieve a high rate of output, the practice could lead to "watertight compartments" where any errors (it was hoped) would be corrected by the next operation.

One was apt to think, with modern equipment such as all-metal patterns and coreboxes, jigs for core positioning and so on, that supervision became less necessary, but the fact was just the opposite. Such matters as half a dozen jolts on a moulding machine when it really should have twelve, or setting cores without the gauge, were often the difference between good and bad castings. Bad workmanship was like a bad habit, the more it was allowed to continue, the more uncontrollable it became. It was necessary for those in control and trust to correct any errors in the early stages, for it was less easy to correct them at a later date.

To achieve a high standard of quality called for teamwork, perhaps more in foundry spheres than in machine-shop production, and this must become a policy to become workable. The responsibility for introducing and maintaining that policy rested with those in executive and supervisory positions.

In conclusion, the president said, let foundrymen by all means follow the American principle and think "big" when dealing with production, but let them coin their own British phrase and think "good" when it came to quality.

A vote of thanks to the president was proposed by Mr. Ward, and seconded by Mr. Whipp.

For the remainder of the meeting, two films were shown, "Lloyd's Nowadays," by courtesy of F. H. Lloyd & Company Limited, and "Making Aircraft Cylinder-heads in Aluminium." The films aroused much interest amongst the members, and a lively discussion followed. A vote of thanks to F. H. Lloyd & Company Limited was proposed by Mr. Hardy, and seconded by Mr. Dobbie.

Scottish—Falkirk Section

The Falkirk section of the Scottish branch of the Institute of British Foundrymen, recently heard a talk on "Apprentice Training" by Mr. Nicholas Curry, principal of the Burnbank Foundry Training Centre, Falkirk. Mr. James McIntosh, junior vice-president, occupied the chair. Mr. Curry opened by defining an apprentice as a novice, and indicated that there had been apprentices ever since man had used tools somewhere about 40,000 years ago, these apprentices learned by mimicry and this method of teaching had never been superseded. Mr. Curry then took his listeners through the 11th and 12th centuries, when merchant- and trade-guilds were formed. These guilds laid down certain standards with regard to the number of apprentices and

Notes from the Branches

the method of training. Craft guilds gradually superseded the merchant-guilds until, during the 14th century journeymen broke away from the craft guilds and set up in competition.

The result of all these changes was that the interests of the apprentice suffered to such an extent that, in 1563, Parliament passed the Statute of Labourers & Apprentices to safeguard apprenticeship. The conditions of an apprentice at this time were wholly controlled by his master with whom he lived as well as learned. Corporal punishment was common, and the apprentice's life was largely coloured by the character of his master. This type of apprenticeship gave way gradually to one where the boy lived with his parents at home and received wages from his employer. The Industrial Revolution and the rise of capitalism marked the end of compulsory apprenticeships, this opening the way to exploitation of cheap labour and resulting in trade unions reviving the old Guild and apprenticeship laws restricting the number of apprentices and establishing conditions of employment. This was the background against which to-day's conception of apprenticeship training must be fitted.

Present-day Systems

Mr. Curry continued by pointing out that throughout Europe and in France in particular, various moves had been tried to rectify the haphazard training of apprentices and with each of these moves the linking of vocational training and general education had been noticed. In our own country, the last two wars had given us Education Acts of wide vision—arranging for continuation classes, raising the school-leaving age and for day-release instruction. He added that there was a great deal of complacency about our own system of education and pointed out that other countries were tackling the problem equally well, although possibly from a different viewpoint. France was a typical example. There, apprentices received all their training outside industry in a school. The French delayed the choice of career until the boy was 14-15, whereas in this country, this was usually attempted at the age of 12. As many aptitudes were not evident until the boy reached the age of 13 to 14, it would appear that the French were on a better psychological basis than ourselves. Germany, Czechoslovakia, Poland and Russia all had separate systems of their own.

Dealing with the position nearer home, Mr. Curry said that in Stirlingshire there were four trade centres operating under the day-release system. These were the County Trade School, for building-trade apprentices; the Mining Institute, for apprentices in the mining industry; Blackbraes Voluntary Part-time Centre, for distributive, commercial and laboratory apprentices; and the Burnbank Foundry Training Centre. Owing to the limited number of hours which could be spent in these centres, many foundries in the district supplemented the training-centre's work with practical training in their own foundries. Mr. Curry then showed a typical timetable for apprentices attending the Burnbank Centre and pointed out its shortcomings, which, he thought, might be improved as the Centre established itself.

London—Slough Section

At the November meeting of the Slough section of the London branch of the Institute of British Foundrymen, held in the lecture theatre, High Duty Alloys Limited, a paper entitled "Does the Patternshop Give the Foundry What it Wants?" was given by Mr. B. Levy, of B. Levy & Company, before an audience of about 60 including a number of apprentices. The Author first detailed some of the factors arising in the consideration of foundry pattern requirements. In posing these points some provocative remarks were made regarding responsibility for design, cost, and functions of equipment. Enterprise in the trying out of different methods apparently contrary to known practice was advocated. Viewpoints of both pattern-maker and foundry foreman were outlined on these points which embraced approximately ten major factors. Consideration was also given to the number of castings required from a pattern, *i.e.*, from one-off jobs progressively up to mass-production.

Although the main viewpoint was that of the subsidiary or patternshop tied to the foundry, questions of expenditure in effort, materials, employment of machinery and general patternshop costs also entered into the treatment.

Slides were shown illustrating typical jobs calling for varying degrees of skill and pre-planning, as well as indicating machinery and individual operation requirements. In the discussion, the availability and use in the industry of standard pattern colours was the major theme. Other aspects considered were casting drawings, *vis-à-vis*, machining drawings, jigging points on patterns and the necessity for the pattern-maker to consider the founders' plant available for the job. Finally, Mr. Levy exhibited a sample plastic pattern, one of a series of eight for one pattern-plate, produced in plaster mould from a single master pattern. This new material, he said, gave a good strip and showed promise of extended application for the smaller range of pattern work.

Bristol and West of England

The opening meetings of the session of the Bristol and West of England branch of the Institute of British Foundrymen have been well supported, and with a varied and interesting programme still to come, the indications are that a most successful session will be enjoyed by the branch. The first meeting at Bristol took the form of presentation of the sub-committee T.S.35 film on "The Flow of Metals." Much interest was aroused as was evident from the many questions put to Mr. J. Hird, who had given the commentary.

For the second meeting, a Paper was presented by Mr. D. H. Potts entitled "Production of Aluminium Patterns using Plaster Moulds." The venue of the meeting was the works of Newman, Hender & Company, Limited, at Woodchester, Glos, to whom the thanks of the branch are extended for the facilities placed at their disposal, and for the refreshments supplied at the close of the meeting. A record attendance of 92 members and friends enjoyed a highly instructive lecture, and Mr. Potts was called upon to answer many questions relating to the economics of the process, mould-curing temperatures, and possible future applications.

The third meeting, at which the speaker was Mr. E. C. Mantle, who presented a Paper "Degassing of Non-ferrous Metals," was held at Bristol. Mr. Mantle gave a very clear picture of the work done in this field up to the present and indicated the most notable applications of the process to everyday practice in foundries. The questions put to Mr. Mantle were many and varied in nature, dealing with the avoidance of porosity in castings; the most effective way of gas introduction into melts; the cost as compared with other degassing methods, and any possible difficulties which may be encountered when using the process.

Canada's Steel and Foundry Industries

Review of Plans to Increase Capacity

During the decade 1940 to 1950 Canadian iron and steel producers carried out an expansion programme which increased capacity in Canada by 75 per cent. During the war years, with Government help, $125,000,000 was spent on repair and maintenance; the erection of blast, open-hearth, and electric furnaces; and the expansion of steel-fabricating facilities. A paper issued by the department of external affairs of the Canadian Government points out that between 1945 and 1950 capital expenditure was devoted generally to modernization of existing mills and to diversification of rolling-mill and other finishing facilities, but that nearly $60,000,000 was spent on new plants.

Among other results of the capital outlay were a new cold-strip mill, an electrolytic-tinning line, and a mill for large diameter pipe to serve some of the growing needs of the Canadian oil and gas industries.

Other additions to plant included coke ovens and improved raw material handling facilities. Expenditure on repair and maintenance totalling $85,000,000 was also made in the post-war period.

Substantial Expansion Schemes

With the steel shortage which developed following the outbreak of the Korean war, the question of further additions to Canadian primary iron- and steel-making capacity arose. The upshot has been that all four major producers undertook substantial new expansions.

The Dominion Foundries & Steel Company, at Hamilton, Ontario, has completed the installation of a blast furnace to produce 300,000 tons a year and of coke ovens and shipping facilities, at an estimated cost of $18,000,000. The Steel Company of Canada, also at Hamilton, Ontario, is currently engaged in a programme which includes erection of a 450,000-ton blast furnace, to be completed by the end of 1952, and 650,000 tons of open-hearth steel-furnace capacity, which will be in full production by 1953. This, together with the necessary dock, storage, and coke-oven facilities, will involve a total outlay upward of $45,000,000.

Algoma Steel Corporation, Limited, at Sault Ste. Marie, Ontario, also has embarked upon an expansion plan which will add a combination mill capable of turning out products such as steel bars, reinforcing rods, and skelp for the manufacture of welded pipe and tubing. The Dominion Steel & Coal Corporation, at Sydney, Nova Scotia, is also carrying forward a programme designed to give higher production. It includes electrification of rolling mills and the construction of steel-furnace capacity. This equipment should be in operation by 1953. New investments by the Quebec Iron & Titanium Company include facilities for making pig-iron as a by-product of titanium oxide from ilmenite ore. Full-scale production of new metal may be reached in 1953.

When the announced plans are completed, capacity for production of pig-iron will have increased 45 per cent. over 1950; of steel ingots by 30 per cent. over 1950; and of rolled and drawn products by 30 per cent. over 1950.

Present Plant and Consumption

The Canadian steel industry is currently operating 412 coke ovens, with an annual rated capacity of 2,600,000 tons; 15 blast furnaces, with an annual rated capacity of 3,000,000 tons; 76 electric steel furnaces, with a rated capacity of 690,000 tons; five blooming mills; five billet mills; numerous bar mills and galvanizing units; and many subsidiary plants producing tacks, nails, screws, rivets, bolts, wire, wire products, forgings, pipes, and a wide range of associated steel products.

Canadian consumption of primary steel as such has been rising for many years. In 1900 it was less than 15 lb. per person (ingot equivalent). By 1920, it had risen to 350 lb. and in 1939 it was 335 lb. *Per capita* consumption in 1950 was approximately 675 lb.

These figures are well below those reported in the United States and are of the same order as those for Great Britain. In 1950, *per capita* usage in the U.S. was 1,200 lb., while in the U.K. it was 630 lb. The apparently low rate of consumption in Canada relative to the U.S. is partly explained by the fact that considerable tonnages of steel are imported in the form of production parts and finished goods such as vehicles, machinery, and equipment. When allowances are made for this, *per capita* consumption in Canada is found to be in the order of 950 lb. a year.

Over the last 50 years the long-term rate of growth in Canadian demand for primary iron and steel has been of the order of 4 per cent. per annum. Therefore, if it is assumed that this trend will continue over the next 10 years, domestic requirements in 1960 will be around 4,500,000 tons of rolling-mill products, or 1,300,000 tons greater than they were in 1950.

In recent years, expansion of Canadian plant has improved the relations between capacities at various stages in primary iron and steel manufacture. But the ingot capacity of several producers exceeds that of their rolling mills. The completion in 1952 of four new open-hearth furnaces capable of producing 650,000 tons of steel ingots a year and the erection of new rolling facilities in 1952 and 1953 will bring primary and secondary capacity into much better balance.

Effective blast-furnace capacity may also be considered insufficient in relation to steel output. However, deficiencies in pig-iron output have been made up by the extensive use of scrap for re-melting. This difficulty will largely be overcome when new capacity now under installation is completed.

Pig-iron and Iron Castings Output

The total supply of pig-iron reached a peak in 1949, when 12 Canadian blast furnaces turned out nearly 2,200,000 tons. Since then, domestic output has risen further. Imports, which are relatively small, have also increased. Exports rose sharply in the period between April and December, 1950, when Government controls were not in effect. As a result, the domestic supply of pig-iron for the year as a whole was slightly lower than in 1949.

In 1951, domestic production of pig-iron reached a new high level, due to fuller utilization of existing capacity and to the introduction of a new 300,000-ton-a-year blast furnace at Hamilton. Another 450,000-ton-a-year blast furnace to be built at the works of the Steel Company of Canada will not be in production until late in 1952. Pig-iron is also a by-product of the smelting of titanium ores. It is expected that production from the new plant at Sorel, Quebec, will reach 175,000 tons annually in a few years time. However, little will be available from this source in the immediate future. Exports in 1952 are likely to be at about the same level as last year. In spite of the improvement in supply, the

Canada's Steel and Foundry Industries

requirements of the defence and development programmes will cause an increase in the current pressure on scrap.

In recent years approximately 80 per cent. of the pig-iron consumed in Canada has been charged to the steel furnaces. The remaining 20 per cent. has been divided almost equally between foundry and malleable pig-iron. Only a relatively small proportion of the basic pig-iron made by the primary steel industry is sold to other steel-using industries. On the other hand, very little of the foundry and malleable pig-iron is used directly by the primary producers themselves.

Demand for basic pig-iron, which remained virtually unchanged from 1947 until the middle of 1950, has since shown a moderate increase. In 1951, an additional 300,000 tons were needed to support a higher level of domestic steel production.

Canadian consumption of foundry and malleable pig-iron has varied much more widely over the past few years. In the years from 1946 to 1948, manufacturers of farm implements, industrial machinery, and rolling stock were increasing their output. Therefore, their consumption of pig-iron rose steadily throughout this period. In 1949 and the first half of 1950, demand from these industries declined. However, with the exception of farm machinery, this trend has again been reversed.

Overall demand for pig-iron of all types in 1952 is likely to be several hundred thousand tons greater than in 1951. These increased needs are being met by additional production.

Steel Castings

Canadian firms make the bulk of the rough steel castings used there. In 1942, they produced 151,000 tons, mostly in electric furnaces. Post-war output reached a peak of 113,000 tons in 1948. Thereafter it declined, due largely to reduced operations in the rolling stock industry. Production in 1950 was only 71,000 tons, while output in 1951 totalled 121,000 tons.

A decided improvement in the supply of rolling-mill products occurred in 1951. Canadian production increased by nearly 160,000 tons over the previous year. Exports were reduced substantially. As from January, 1951, exports of semi-finished steel for further processing were prohibited except in special circumstances. Increased imports also helped substantially to improve the Canadian supply position last year.

House Organs

Sif-Tips. Vol. 15, No. 79. Issued by Suffolk Iron Foundry (1920), Limited, Sifbronze Works, Stowmarket, Suffolk. This issue carries all the usual features, and amongst them is a useful article on "Know your Metals," where a number of hints on identification are given.

Bulletin and Foundry Abstracts Vol. II, No. 9. Published by the British Cast Iron Research Association, Alvechurch, Birmingham.

There is much more news in this issue that has been the case in the past, due to the association's ever-increasing activities. The special article is a useful bibliography on statistical quality control, a subject which should always have a prominent place in works management.

Sintered *v.* Cast Products

At this year's congress on powder metallurgy at Stockholm, Mr. W. Hotop, of the Deutsche Edelstahl-Werke, gave an interesting paper on the manufacture of permanent sintered magnets. His company is one of the largest sintered magnet manufacturers in the world, and while the major part of his remarks may not have been new for his competitors, it perhaps is not widely known that sintered magnets are claimed to have the same magnetic properties as cast magnets, and markedly superior mechanical properties. In sizes up to 2 oz., they are also said to be cheaper to make by sintering than by casting. At the same time, the Author gave one instance in which 11 oz. and 14 oz. magnets were made by sintering rather than by casting, in spite of the far higher price, owing to the fact that particularly high mechanical properties were required. The application was for dynamos for underground lighting in mines.

Manufacture of Structural Parts

Another paper of a general character by G. Zapf (Husqvarna Vapenfabriks A.B.) was a short treatise on the manufacture of structural parts from powders as viewed through European eyes. Whilst the technical aspects were largely the same as those encountered in the United States, the Author made it clear that the economic factors were not entirely identical. The fact that in the U.S.A. iron-powder metallurgy could compete successfully with cast-iron metallurgy in the field of small parts was due to the high labour costs in American foundries. Small grey iron castings were comparatively more expensive, he said, in the U.S.A. than in Europe. Powder metallurgy in a great many European countries was not in the same favourable situation and had to reckon with severe competition from iron foundries.

Moulding-machine Design

Writing in *Gjuteriet*, A. V. Broberg, of Stockholm, contributes a long article entitled "Aspects on the Design of Pneumatic Moulding Machines," in which the moulding-machine committee of the *Mekanforbundet* (foundry division of the Swedish Federation of Mechanical Engineering Industries) present the foundryman's view on how to re-design moulding machines to obtain improved service life, better performance and simplified operation. The purpose is to aid the manufacturers of moulding machines in the development of better products. The committee makes the following recommendations; better engineering materials should be selected; machine weight should be reduced; the design should be based on proper calculations; foundations should permit inspection; well-designed machine bases with jig-drilled bolting-down holes are recommended; air pipes should be completely built in; all moving parts ought to be protected against sand; centralized lubrication and correctly located valves are recommended; the machines should be painted in light colours with safety signs; automatic operation safety precautions and instruction also in Swedish (for foreign-built machines) are recommended. In the second part of the Paper, the design of moulding machines is discussed in detail and a number of design suggestions is given. Among the recommendations can be mentioned that ball bearings should replace sleeve bearings, the former being more easily fitted, jolt-timers and pressure gauges ought to control operation; fool-proof box-clamps and locking pins add to safety and faster lifting-pin movement increases production.

Teeming by Remote Control

Designed to increase safety and reduce manual labour, a hydraulic device enabling teeming from ladles with remote "push-button" control, has been developed in the U.S.A. by Republic Steel Corporation and is now being manufactured by the American Blaw-Knox concern. It is known as the "Autopour," and since the pressure for opening and closing the stopper is limited only by the physical strength of the stopper rigging, greater opening and closing force can be exerted. Leakers and dribbles are thus minimized and sticking stoppers, due to skull forming in the ladle, are reduced. The hydraulic control is both sensitive and accurate, enabling the opening to be barely cracked or opened to any extent so that puddling the bottom and topping-off are simplified and the taking of spoon samples is facilitated. At one plant, the pouring is done from the crane escape platform. It is possible that the British company, Blaw Knox, Limited, will be producing this type of equipment in the near future. Fig. 1 shows a push-button control unit in operation on ingot teeming.

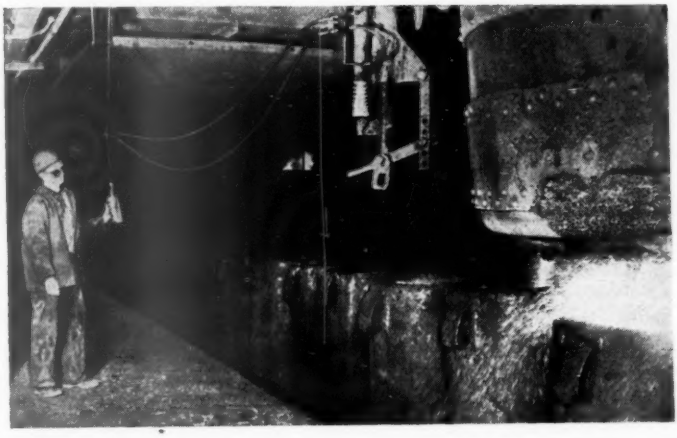


FIG. 1.—*The Autopour in Service.*

Metal/Mould Reaction

In a paper on the effect of metal/mould reaction on 85/5/5/5 leaded gunmetal sand castings, which Mr. N. B. Rutherford, B.Sc., of the British Non-Ferrous Metals Research Association, has contributed to the Institute of Metals, the following conclusions, based on both laboratory experiments and industrial trials, were printed:—

(1) Metal/mould reaction may be used as a possible means of improving the yield of pressure-tight sand castings containing heat centres. When compared with earlier work, the results now reported indicate that the advantage to be gained with leaded gunmetal is less than with phosphor bronze and lead-free gunmetal. (The earlier work showed that leaded gunmetals are less prone to develop localized and harmful porosity than are the phosphor bronzes and lead-free gunmetals.)

(2) Laboratory experiments and industrial trials have shown that metal/mould reaction can improve the strength and pressure-tightness of 85/5/5/5 leaded gunmetal castings containing heat centres, when the rate of solidification is rapid, either because of the thinness of the section or the use of a low pouring temperature.

(3) Additions of phosphorus to the leaded gunmetals to promote metal/mould reaction should not, therefore, be made indiscriminately. In castings with section thicknesses of ¼ in. or more metal/mould reaction may be harmful unless the pouring temperature is kept as low as possible consistent with running the casting. For the conditions described in the Paper the pouring temperature must be below 1,100 deg. C. In foundry practice it is usual to pour a number of castings from one crucible or ladle, and some latitude in pouring temperature is necessary. In some circumstances, therefore, a restriction on pouring temperature may prove impracticable.

(4) The presence in the metal before pouring of moderate amounts of gas (equivalent to about three per cent. porosity in a D.T.D.-type test-bar) may cause leakage in what would otherwise be sound castings, but the absorption of similar amounts of gas from the mould during freezing does not have this deleterious effect.

(5) The application of aluminium/magnesium alloy paint to the surface of sand moulds prevents the absorption by 85/5/5/5 leaded gunmetal of gas arising from metal/mould reaction.

(6) When 85/5/5/5 leaded gunmetal with a high residual phosphorus content (greater than 0.04 per cent.) is cast into unpainted sand moulds from a high pouring temperature (1,200 deg. C.) marked gas absorption occurs; this may reduce the tensile strength of 1-in.-dia. D.T.D.-type test-bars by over one-third. The application of the inhibiting paint under these conditions gives improved tensile properties.

(7) Bars with smaller amounts of absorbed gas due to metal/mould reaction (equivalent to about 3 per cent. or less porosity in the test-bar) have strengths some 25 per cent. higher than those in which gas absorption is prevented by painting the mould with aluminium/magnesium alloy paint.

(8) The grain-size of sand-cast 85/5/5/5 leaded gunmetal is markedly dependent on pouring temperature; with section thicknesses of ¼ in. to 1 in. castings poured from 1 050 deg. C. have grain-sizes of the order of one-tenth of those in similar castings poured from 1,200 deg. C.

Record Steel Output in November

Both steel and pig-iron production last month reached the highest annual rate ever recorded in the industry. November steel output was at an annual rate of 17,951,000 tons, compared with an annual rate of 17,044,000 tons in the previous month and of 16,437,000 tons in November, 1951. Last month's pig-iron production was at an annual rate of 10,753,000 tons, against a rate of 10,616,000 tons in October and of 10,194,000 tons in November last year.

Last month's steel production broke a two-year record, the previous best month in the industry's history being November, 1950, when an annual rate of 17,472,000 tons was reached.

Production is now being steadily maintained at above the previous peak rates established in 1950. The latest advance follows the progressive fulfilment of the industry's post-war development plan which was started in 1946 and is due for completion by mid-1953.

Latest steel and pig-iron output figures (in tons) compare as follow with earlier returns:—

	Pig-iron.		Steel ingots and castings	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1952—October ..	204,200	10,616,000	327,800	17,044,000
November	206,800	10,753,000	345,200	17,951,000
1st eleven months	202,000	10,504,000	309,400	16,087,000
1951—October ..	189,700	9,865,000	300,600	15,629,000
November	196,000	10,194,000	316,100	16,437,000
1st eleven months	185,000	9,618,000	301,800	15,696,000

Scots Lead and Zinc Mining

The original plans of Bangrin Tin Dredging Company, Limited, and Siamese Tin Syndicate, Limited, for exploring the possibilities of reopening the lead and zinc mines at Leadhills and Wanlockhead (Lanark) were suspended in July last, when the boards decided to seek further associates. A tentative agreement recently reached with the Rio Tinto Company, Limited, provides that all three companies would take over the enterprise jointly, the Rio Tinto Company to provide 51 per cent. of the funds needed, the balance being found equally by the other two companies. The immediate object of dewatering and examining the Glencrieff working at Wanlockhead will cost approximately £150,000, and, if favourable, to proceed to development and production will, it is estimated, take £350,000.

When the second stage has been reached, the decision will be made whether to continue the joint venture or to form a limited company, with subscriptions in the same proportion. On the first stage the gross estimated risk of Bangrin Tin Dredging Company and Siamese Tin Syndicate would be £46,250 each, while the second stage would entail a further £120,525 for each undertaking. The directors refer to the Paley Report which indicated that world reserves of metals, particularly lead, were being exhausted faster than new sources were being discovered, and they feel that if expectations were realized the enterprise should prove profitable.

DUNLOP RUBBER COMPANY, LIMITED—Mr. D. B. Collett, an executive director, has been appointed a director.

New Patents

The following list of patent specifications accepted has been taken from the "Official Journal (Patents)." The numbers given are those under which the Specifications will be printed and all subsequent proceedings will be taken. Applications for copies of the full Specifications (2s. 8d. each, post free) should be made to the Patent Office, 25, Southampton Buildings, Chancery Lane, London, W.C.2.

682,705 FOX & COMPANY, LIMITED, S., BOLSOVER, G. R., BAGNALL, F. T., and WILCOCK, R. Processes for the production of steels of low carbon content.

682,718 DORR COMPANY. Process for the heat-treatment of ores.

682,821 BADISCHE ANILIN- & SODA-FABRIK. Production of metal powders by carbonyl process.

682,832 NORTHFIELD MINES, INC. Recovery of metals from sulphur-containing metallurgical slag.

682,927 METALLGES. AKT.-GES. Process for removing volatile impurities during the blast sintering or roasting of raw or smelted ores.

682,936 BABCOCK & WILCOX, LIMITED. Welded joints between austenitic and ferritic metal members.

683,088 HIGH DUTY ALLOYS, LIMITED, and HANSTOCK, R. F. Reducing the residual stresses developed in metal objects by rapidly cooling or quenching them.

683,144 SADLER, A. L. (Ajax Engineering Corporation). Method of, and apparatus for, die-casting metals.

683,146 WILD-BARFIELD ELECTRIC FURNACES, LIMITED, SIMS, C. W., and ELLIS, C. C. Electric resistance elements.

683,207 STEWARTS AND LLOYDS, LIMITED. Protective coverings for metal pipes, cables, etc.

683,239 STANTON IRONWORKS COMPANY, LIMITED. Manufacture of cores and moulds for hollow metal castings.

683,326 AKTIEBOLAGET AKERS STYCKEBRUK. Cores for casting purposes.

683,330 THOMAS & BALDWINS, LIMITED, R., AGNEW, JUN., A., and BISHOP, D. A. Production of steel ingots.

683,442 SAUTER, H., and HAHN, W. [trading as HAHN & KOLB]. Die-casting and injection moulding machines.

683,462 CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, CHALIN, C. E. J., and EPELBOIN, I. Electrolytic treatment of metals.

683,488 REGIE NATIONALE DES USINES RENAULT. Preparation of gas for use in case-hardening steel.

684,013 COMPTOIR INDUSTRIEL D'ETIRAGE ET PROFILAGE DE METAUX. Hot deformation of metals.

684,119 MEEHANITE METAL CORPORATION. Grey cast iron.

684,249 SIMON (HOLDINGS), LIMITED, H., and HOFFMANN MANUFACTURING COMPANY, LIMITED. Roller journals for roller mills.

684,308 HUTTENWERK RHEINHAUSEN AKT.-GES. Treatment of blast-furnace slag.

684,358 KOPPERS GES., H. Safety means for gas-producers.

684,395 GIBSON, W. A. Making sand moulds and cores.

684,409 UNITED STEEL COMPANIES, LIMITED, and BOOTH, A. G. Supply systems for open-hearth steel furnaces.

684,432 WILLIAMS, W. S., WILLIAMS, J. H. V., and WILLIAMS, J. X. Process for the inoculation of iron.

684,572 WEIL, W. M. Preparation of boron.

684,865 BRITISH ALUMINIUM COMPANY, LIMITED. Determination of the gas-content of liquid metals.

685,046 BOLTON & SONS, LIMITED, T., and JAMES, G. G. Heat-treatment of wire.

Increased European Steel Output

Steel output in member countries of the Organization for European Economic Co-operation rose from 51,000,000 tons in 1950 to 56,600,000 tons in 1951, stated the organization's iron and steel committee in a report submitted to the executive committee recently. But this figure could have been raised by an additional 1,500,000 tons had the necessary raw materials been available. For the same reason, total output in 1952 may be 2,000,000 or 3,000,000 tons short of production capacity available, the report added.

If maximum output was to be attained this year, 41,100,000 tons of scrap and 50,800,000 tons of pig-iron—increases over 1951 of 2,300,000 and 7,400,000 tons, respectively—were necessary. This would, however, entail increasing net imports of scrap from non-member countries from 1,100,000 tons in 1951 to 2,800,000 this year, and this quantity was unlikely to be available, it was stated.

In the case of pig-iron, it appeared that on the original estimates for 1952, lack of raw materials would result in production falling short of the target by some 2,000,000 tons. Efforts were made by ore producers in the early part of the year to increase output. This trend had since continued, and with better supplies of iron ore, combined with better supplies of coke, a total steel production in 1952 of between 61,000,000 and 61,500,000 tons could perhaps be reached.

Fewer Ships Built in North-east

The steel shortage in the shipbuilding industry is reflected in returns issued recently by Sunderland and Tyne shipbuilding yards, which show a decrease in output on last year's figures. Production on the Wear, where 26 vessels of 170,442 tons gross have been launched, is the lowest for any year since 1939. Of this total 58,422 tons, representing eight ships, were for owners overseas. The largest individual output was that of Wm. Doxford & Sons, Limited, which launched five ships of 42,662 tons gross. Sunderland engine builders fitted 21 ships with engines of a total of 84,698 h.p. Order books were stated by a member of the Wear Shipbuilders' Association to be well filled.

On the Tyne 26 ships will have been launched by the end of the year giving a total of 195,798 gross tons. This was a decline of 13 ships and 43,902 tons on the figures for last year, when a post-war record was established. For the first time since 1948 production on the Tyne fell short of 200,000 tons gross. The 26 ships launched consisted of eight oil tankers, four passenger ships, one cargo liner, six cargo ships, three coasters, three barges, and a cable ship. There was, however, an improvement at Blyth, where the Blyth Dry Docks & Shipbuilding Company, Limited, launched two ships of 7,783 tons, compared with nothing last year. Marine engineering firms on the Tyne manufactured geared steam turbine machinery of 19,615 h.p. during the year.

MR. EDWIN BASS, of Rudolf Bass, 175, Lafayette Street, New York, 13, is desirous of representing U.K. manufacturers of woodworking and light metal working machine tools. Interested makers should communicate direct with the inquirer at the address given, at the same time advising the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1 (reference, CRE/36792/52), of any action taken.

Residual Stresses in Aluminium-alloy Sand Castings

A study has been made by R. A. Dodd, M.Sc., Ph.D., in a Paper before the Institute of Metals, of the extent to which the residual stresses in aluminium-alloy sand castings to British Standard 2L42 (R.R.59), of a design known to induce residual stresses, are determined by the following variables: (*a*) percentage water in the mould, (*b*) pouring temperature, (*c*) time elapsing between pouring and stripping the casting, and (*d*) mould strength (green- and dry-sand). These variables were chosen as being likely to affect the relative cooling rates of parts of the casting of different cross-section, mould strength being the exception. The strain consequent on sectioning the casting was measured by means of electrical-resistance strain-gauges in a part of the casting subjected to a uni-axial tensile stress, the stress being determined by the relationship: stress = strain × Young's modulus.

It is shown that only in the case of certain designs is it theoretically possible for the stresses to vary with the moulding and casting practice, and that in such cases they are related to the variables investigated as follows: (*a*) The stress increases approximately linearly with increase in percentage water in the moulding sand. Over the practical range of water content (5 to 6.5 per cent.) for the naturally-bonded sand used, the stress increase is not considerable. (*b*) The stress increases rapidly with increase in stripping-time up to the order of 10 min. Beyond this time, the rate diminishes considerably, maximum stress being attained in 1 hr. (*c*) A very slight increase in stress is observed with increase in pouring temperature. (*d*) Mould strength exerts no effect on the stress magnitude.

Non-sparking Tools

In the November issue of the *Gas Journal*, Mr. C. H. Meigh, managing director of Meigh Castings, Limited, Cheltenham, describes and illustrates the care and maintenance of a line of non-sparking tools made for the gas industry. The metal of these tools is a copper/aluminium base alloy containing nickel, manganese and iron in equal proportions. The range, which are cast products, include a 12-in. by 14-in. shovel embodying a cored shaft. The article is thoroughly practical and details such items as the nature of the flux to be used when welding broken parts.

Liege International Fair

The Liège International Fair, to be held from April 25 to May 10, 1953, aims at drawing the attention to new developments in technique, and to give regular exhibitors the opportunity of striking a fresh note by showing some particular aspect of their production programme. It is to have the following specialized exhibits:—(1) Coal mining by mechanical means and by explosives; (2) equipment and products of iron-smelting industries; (3) power engines; (4) equipment for the food industry, and (5) electronics in industry.

BELIEVED TO BE the largest consignment of agricultural machinery ever sold to that country by a British company, 100 Diesel tractors and ploughs were recently shipped to Yugoslavia by David Brown Tractors, Limited, Huddersfield (Yorks).

Company Meeting

Hale & Hale (Tipton), Limited

Steady Advance in Activities

MR. W. EDGAR HALE ON HEAVY TAXATION

The 16th annual general meeting of Hale & Hale (Tipton), Limited, was held on December 17 at the Station Hotel, Dudley, MR. W. EDGAR HALE, M.I.Mech.E., the chairman, presiding. The following is an extract from his circulated review:—

The profit and loss account of the holding company shows a trading profit of £101,310, which compares with £89,385 for the previous year and thus shows an increase of £11,925. Taxation, including a provision of £8,000 for the new Excess Profits Levy, amounts to £52,604. The net profit, which stands at £39,029, represents an increase of £2,882 over the figure for the previous year of £36,147.

Your directors consider that restraint in dividend policy should still be maintained and recommend that the final dividend on the ordinary shares should be at the rate of 17½ per cent., less tax, making a total distribution for the year of 25 per cent., less tax, which is the same as that for the year ended August 4, 1951. The final dividend takes £9,188 and it is proposed that £20,000 shall be transferred to general reserve account and £3,000 to taxation reserve account, leaving a balance to be carried forward of £12,974, which is similar to the balance brought forward of £12,958.

The consolidated trading profit for the year amounts to £143,717, as compared with £120,077, and shows a satisfactory increase of £23,640. The consolidated balance sheet shows fixed assets at £200,042, an increase of £38,395 over the value a year ago, and current assets at £404,843, representing an increase of £37,670. On the other side of the balance sheet the capital, reserves, and undistributed profits at £481,957 show an increase of £46,296. The current liabilities of the group amount to £190,087, which compares with £160,318 a year ago, an increase of £29,769.

It will be observed that the group has an excess of current assets over current liabilities of £214,756, as compared with £206,855 at August 4, 1951, so that there is an increase of £7,901.

Sales and Production

Over the past 12 months there has been a steady increase in our sales, with which our production has been keeping pace, but over the last few months there has been a slight recession due to the indefinite export position.

There has been a temporary curtailment of programmes in the agricultural and motor industries, but, on the other hand, there is a healthy development of business in other fields, which we are confident will go a long way to satisfying our increased production potential. With increased production facilities, in most directions our delivery time is improving, and we are now in a position to give better service both to our established customers and new friends.

Our output over the past year of Hales' Fine Blackheart Malleable Iron, and "Permalite" Castings has increased over the previous year and we look forward to achieving an even higher target for the current year. The Hales' shipbuilding wedge, which was introduced last year, has found much favour, and some thousands are now in use in shipyards in this country and abroad. Important developments are in hand for new colliery products, which, at this stage, appear to be very promising indeed.

Although it is generally felt that we are entering a competitive era, we can face this with every confidence in the products we have to offer, and the constantly improving methods of production at our disposal. It would appear that without any exception, ever since we have been a public company, some portion of our activities has always been concerned with production of material of an essential armaments character due to occurrences over which we have no control; and this year has been no exception.

Whatever the future may hold in store you may rest assured that your company will be able to offer a good account of its efforts, no matter with what it may be called upon to deal. Apart from this feature, the year has been one typical of its predecessors and one generally of steady advancement in all our activities, due in the main to the very splendid effort which has been made by the whole of the staff and employees concerned. I will take this early opportunity of extending to them on your behalf a very sincere "Thank You" for all that they have done during the year. As last year, all the employees have shared in a special bonus sanctioned by your directors, and this bonus has already been accounted for in the figures presented to you.

I should also like to thank the shareholders for loaning their hard-earned savings of bygone years, thereby supplying all our needs in the way of plant, buildings, and raw materials, which are, of course, absolutely essential for our activities.

I have already mentioned that war preparation in the ordinary sense of the term has had some bearing on our activities; but there is another kind of "war" that must develop—that is between the productive industries and the Chancellor of the Exchequer, for it is quite impossible for industries to continue successfully at the present high rate of taxation. We know that something had to be done to check the continuous inflation which was taking place in the country by virtue of the fact that much money was being spent on capital account which could have been deferred for some time. Because of the high level of taxation, this problem has now been dealt with this year by the new taxation and the cancelling out of the special depreciation allowance which was allowed in the year of purchase, but every effort must be made to impress upon the Chancellor that taxation must be checked if productive industry is going to remain strong and healthy. The position of raw materials continues to be difficult.

Subsidiaries

CHATWINS, LIMITED.—This subsidiary is holding its enviable position in the solid-fuel appliance field, and its well-known range of products issued under the trade name of "Sunbeam" is proving its worth all over the country. Improvements are constantly in mind, and new appliances are likely to make their appearance during the coming year which will further enhance the name of "Sunbeam." The firm has a full order-book and production is increasing.

J. & J. WHITEHOUSE (TIPTON), LIMITED.—Although this subsidiary has an attractive order-book, we have to record some concern with production due to the difficult labour position in this industry, but I am assured that steps are in hand for overcoming this problem in the not too distant future. Their products, as you know, are chiefly cast-iron holloware, and under the trade name of "Phœnix" find their way to the tropics for native uses.

Personal

MR. LESLIE DRIFFIELD, a director of Ellerby Foundry, Limited, Leeds, has won the world's amateur billiards championship.

MR. HENRY J. TRENKAMP, president of the Ohio Foundry Company, Cleveland, has been elected president of the Gray Iron Founders' Society.

MR. L. E. YOUNG, sales manager of Southern Forge Limited, of Langley, Bucks, one of the Almin group of companies, has been appointed a director of the company.

MR. CLAUDE B. SCHNEIBLE, president of a company bearing his name, and located in Detroit, has been elected president of the (American) Foundry Equipment Manufacturers' Association.

MR. JOSEPH F. M. BRAITHWAITE, a director of Baker Perkins, Limited, manufacturing engineers, etc., of Peterborough, has been appointed a member of the board of management of the company as from December 31. He joined the company as a sales representative in 1946, and has been a director since 1950.

MR. S. J. HARLEY, chairman, and MAJOR G. W. MOORE, deputy chairman, of Coventry Gauge & Tool Company, Limited, have been appointed to the board of Pitter Gauge & Precision Tool Company, Limited, Leatherhead (Surrey). Mr. Harley has been elected chairman of the board in place of BRIG.-GENERAL R. F. LEGGE, who has retired from the chairmanship, but remains a director.

AT THE FIRST annual dinner of Brown's Foundry Company, Limited, on December 10, at the Albert Rooms, Derby, MR. JACK HUMBER, foundry foreman, who has retired after 55 yrs.' service, was presented with a cheque on behalf of the firm, by Mr. Wilfred J. Brown, a director. A colleague records that Mr. Humber made the castings for the railings outside the Ulster Houses of Parliament.

MR. J. E. V. JOBSON has succeeded the late Mr. J. A. Prestwich as chairman of J. A. Prestwich & Company, Limited, petrol engine and air compressor manufacturers, of London, N.17. Mr. Jobson, who is chairman and managing director of Qualcast, Limited, light repetition steel and iron founders, of Derby, and a director of Allied Ironfounders, Limited, Wellington (Shrops), is succeeded as vice-chairman of J. A. Prestwich & Company by MR. E. S. PRESTWICH, the managing director.

MR. D. G. HAWKINS has been appointed general manager of the National Gas & Oil Engine Company, Limited, Ashton-under-Lyne (Lancs). He is already a director of the company. Mr. Hawkins joined the Brush Electrical Engineering Company, Limited, in 1945, and after holding various executive positions, went to Petters, Limited, as sales director in 1949. In November last year he joined J. & H. McLaren, Limited, where he was concerned with the reorganization of the factory's products.

A 50-TON ENGINE TEST PLANT for the largest type of marine Diesel engines was completed recently and shipped to Copenhagen by Heenan & Froude, Limited, Worcester.

THE NEW ADDRESS of the London office of Thos. Firth & John Brown, Limited, is 11, Hamilton Place, Piccadilly (Hyde Park Corner), W.1 (telephone: GROsvenor 8781).

FORTY-EIGHT MEN and one woman, who this year have completed 25 years' service with Accles & Pollock, Limited, tube manufacturers, of Oldbury (Staffs), are to receive gold watches.

Foundry Firm's Extensions Opposed

Official Lethargy and Frustration

Mr. Arthur Croft, chairman and managing director of Crofts (Engineers) Limited, speaking at the fourth annual dinner in Bradford on December 3 to more than 160 managers and heads of departments, described the refusal of Government Departments to grant the firm permission to build extensions for the benefit of dollar trade as both "frustrating" and "lethargic." The directors had given much consideration to re-planning the engineering side of the works to enable it to be brought to the highest state of efficiency in order meet competition from all quarters. With the plans of various extensions completed, their programme had yet been upset by the unsympathetic attitude of Government Departments, who refused to grant permission to build.

The firm was still compelled to continue working under the greatest difficulties, to such an extent that it had led to a hold-up of schemes decided upon for increasing exports to dollar and other areas, which Mr. Croft considered tragic, when the country was in need of overseas trade. He himself had travelled the world to ensure that employment was reasonably well maintained at the works whatever the home trade was like, but all the time money and effort would be wasted if they were not allowed to build their further extensions which were not excessive, without delay. He urged the Government Departments to go into these matters more thoroughly. In industry, firms were tired of the lethargy and frustration which met them at every turn; manufacturers required from those sources much greater enthusiasm and help. Mr. Croft reminded his audience that entertainment and sport were not the only important things to-day, as might be inferred from newspaper headlines. Such things could not continue if trade and work—the lifeblood of the nation—failed. This was recognized by all responsible people, but apparently insufficiently in official circles.

Mond Nickel Fellowships

Among the Mond Nickel Fellowships announced for 1952 is one to a present holder of a Founders' Company Fellowship, Mr. F. G. Horton (National Foundry College, Wolverhampton). He will use it to study casting production methods in the United Kingdom and on the Continent, with special reference to shell moulding, centrifugal casting, and sand/cement moulding. Other awards have been made to Mr. H. A. Longden (Steel Peech & Tozer, Limited, Sheffield) to study metallurgical control methods; to Mr. G. P. Kempson (Henry Wiggin & Company, Limited, Birmingham) to study the development, application and control of ferrous and non-ferrous melting and ingot casting processes; and to Mr. A. G. Duce (Joseph Lucas (Gas Turbine Equipment), Limited, Burnley) to study the metallurgy and testing of materials.

Latest Foundry Statistics

According to the British Bureau of Non-ferrous Metal Statistics, during the first three quarters of this year, the foundry industry cast 2,419 tons of phosphor-bronze sticks and used 14,486 tons of brass ingots. Both these figures are distinctly less than 1951. However, the production of copper-base castings for the first ten months of the year, 44,565 tons, showed an increase of 1,314 tons, as against the corresponding period of last year.

News in Brief

A FULL-TIME RESIDENT MEDICAL OFFICER is to be appointed by Hadfields, Limited, the Sheffield steelmakers, and medical facilities at the company's works are to be reorganized.

TO-MÔRROW, eleven apprentices of W. & T. Avery, Limited, Smethwick, who have passed examinations at technical college on day release schemes, will receive "achievement awards" totalling £70.

E. & L. B. PINKNEY, LIMITED, engineers, founders, machine-tool specialists, of Grange Road, Middlesbrough, have opened a London office at 120, Victoria Street, London, S.W.1. Tel.: VICtoria 3670.

ASHWORTH, ROSS & COMPANY, LIMITED, manufactureres and repairers of all types of industrial weighing machines, have removed from old premises in Arundel Street, Sheffield, to a new building in Brown Street.

LIEUT.-COLONEL R. K. MORCOM and Mr. J. M. Walshe were among the 26 members of the firm of Belliss & Morcom, Limited, Birmingham, to whom gold watches were presented on December 10 to commemorate 50 or more years' service with the company.

RADIOVISOR PARENT, LIMITED, have recently celebrated their 25th year as designers and manufacturers of photo-electric equipment. They were the first company to develop industrial photocell applications in this country, and in 1927 patented the first really practical commercial light-sensitive cell.

THE FIRST TWO Diesel locomotives to reach Rhodesia arrived from America recently, being part of a batch of six. By about the beginning of 1954, Rhodesia expects to have 29 Diesel locomotives; the remaining 23 will be British. All the locomotives operating on the Umtali to Salisbury section will eventually be Diesels.

THE *Stabilizer*, the well-known house organ of the Lincoln Electric Company, Limited, Welwyn Garden City, Herts, was originated 25 years ago by the company in America with the idea of being helpful to welding personnel. It is now being printed in Great Britain and each issue will contain many items from Great Britain and Europe.

A "CONSIDERABLE MEASURE OF CO-OPERATION" has been arranged between Drake and Fletcher, Limited, and Kent Engineering Foundry Limited, of Maidstone, in the interest of customers at home and abroad. It it understood that there will be some standardization of production and co-operation in design, resulting in an immediate increase in the range of machines offered and services available.

THE FIRST of its children's Christmas parties was given by F. H. Lloyd & Company, Limited, steelfounders, Wednesbury, on Saturday, December 6 when 420 youngsters were entertained. A second party followed on Saturday, December 13, when a similar number of employees' children were guests of the firm. Altogether the company is distributing 1,600 presents to the children of its workpeople.

THE American Engineering Corporation, Fed. Inc., U.S.A., of 310-11, Edinburgh House, Hong Kong, wishes to represent U.K. manufacturers of Diesel engines and air compressors. Interested makers should write direct to the company at the above address, at the same time notifying the Board of Trade, Commercial Relations and Exports Department, Horse Guards Avenue, London, S.W.1 (reference, CRE/40138/52), of any action taken.

LAST THURSDAY the directors of Samuel Osborn & Company, Limited, of Sheffield, made presentations to 33 of their old employees who had served the firm for 50 years or more. The presentation took the form of a leather pocket wallet, suitably inscribed, containing cash. The chairman and managing of the Company, Mr. Frank A. Hurst, who has 55 years' service, presided. The gifts were presented by Lady Osborn. The total service of those receiving presentations is 1,823 years.

ALL EMPLOYEES and pensioners of three Birmingham firms, Henry Wiggin & Company, Limited, Ladywood; Birlec Limited, Erdington; and Mond Nickel Company, Limited (Development and Research Dept.), Ladywood, received, during the week ending December 13, a box containing fruit, chocolate, ham and other seasonal fare. The parcels are from the parent concern, the International Nickel Company of Canada, which has sent similar gifts to their employees in Great Britain every Christmas since the war.

OWING TO DELAY in obtaining delivery of the necessary materials, a scheme proposed by Imperial Chemical Industries, Limited, to reduce the electricity consumption of its Prudhoe-on-Tyne works from the national grid is not likely to be completed until the end of next year. The company proposes using steam-pressure from a sulphate of ammonia drying plant to operate a turbo-generator. The saving in production costs brought about by the new plant will, it is estimated, pay for the plant within two years.

TWO NEW 16 and 35 mm. sound films, "E.R.W." and "The Great Jib" produced by Ace Distributors were given a Press preview in London last week. "E.R.W." stands for "Electric Resistance Weld," a steel tube-making process in which cold-rolled steel strip is cold-formed into a cylinder and the abutting edges are welded by means of a comparatively high frequency current without the addition of any weld metal. The second film tells the story of the design and construction of the tubular steel jib of the W.1400 walking dragline built for Stewarts and Lloyds' ironstone quarries.

BORAXO, a powder hand-cleanser developed by Borax Consolidated, Limited, contains no insoluble or abrasive fillers, and the scouring action necessary to remove ingrained dirt, or to penetrate oily films, is provided by the small grains of borax, which slowly dissolve during the wash. Boraxo in water solution is mildly alkaline. It has a pH value of 9.3, which is claimed to be sufficiently low to ensure no chemical damage to the skin and to prevent undue removal of natural fats. The cleanser is designed principally for industrial use; executives responsible for welfare are invited to test it in their own works. A working sample and full information will be sent, on request, by the makers—Borax Consolidated, Limited, Regis House, King William Street, London, E.C.4.

A NEW LAYOUT at the factory of John Harper and Company, Limited, ironfounders and engineers, Willenhall, is expected to be completed within the next few months. The dressing, inspection and shotblasting sections are to be combined for both grey iron and Meehanite, and a new rough-dressing section is to be opened. This is to be fully mechanized, with waste sand and unwanted material falling through grid-top benches on to a series of moving belts which will carry them to storage hoppers. To enable the new layout to be studied, and the flow of work checked, a scale model of the section has been built. When the scheme is completed, it is anticipated there will be a very large saving of floor space and substantial economy in manpower and skilled moulding time.

FOUNDRY & METALLURGICAL F.&M.S.L.

To all our friends
Christmas Greetings
and Sincere Good wishes
for the Coming Year

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AND
MAGNETIC SEPARATORS
Electric and permanent

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Who is the spanner in the works ?

Are you sure it isn't you?

Have you combed every bit of scrap out of your factory ? Even if steel is not one of *your* raw materials you will nevertheless have some scrap in your works.

Wherever machinery is used there will be scrap — scrap iron and steel.

Look for it in your factory and get it away off your hands.

Remember, a ton of this scrap, which is no good to you in its present form, can make a ton of new steel to help the national effort.

What is Scrap?
All iron and steel that has outlived its effective purpose.

Where should it go?
To your local scrap merchant. He will be glad to help with dismantling and removal of obsolete and redundant machinery.

Issued for the STEEL SCRAP DRIVE, by the British Iron and Steel Federation and the National Federation of Scrap Iron, Steel and Metal Merchants

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Raw Material Markets

Iron and Steel

The ironfoundries are nowhere near as busy as they were. Some sections of the industry, such as the producers of castings for the motor, tractor, and Diesel-engine industries, have been more affected by the recession than, say, the foundries catering for the shipbuilding trades and some of the speciality foundries. The demand for castings from the shipbuilding industry and from some of the general engineering and speciality foundries is as strong as ever, depending on the type of casting produced. The foundries making ingot moulds are not short of work, as the improved outputs of ingots at the steelworks require all the moulds that can be acquired, necessitating large supplies of hematite.

Since the closure abroad of some of their markets, the decline in the demands from the motor and tractor industries has had a serious affect, not only on the foundries, but on other industries, resulting in short-time working and in some cases suspension of labour. Only quite recently double shifts were being worked by some of these foundries, which today have barely sufficient work to maintain a four-day working week.

Work at the light and jobbing foundries has also in many instances declined. Most of these foundries are indirectly affected by the decline in export trade, and business at home has slackened considerably for many articles for which they produce castings, notably household equipment. There are not enough orders being placed to keep all these foundries fully employed, and keen competition results for business which arises.

Pig-iron supplies are generally sufficient to meet the reduced demands made by the foundries, but even these do not permit of any appreciable surplus between outputs and deliveries. The low- and medium-phosphorus irons are fully absorbed, and outputs of hematite, which have recently been on an improved scale, are not too plentiful for the foundries, as large tonnages are being sent to the steelworks. Supplies of high-phosphorus pig-iron for the light and jobbing foundries just about meet their needs at present, but larger supplies are expected towards the end of this month or early in January, when more furnaces will be producing this grade. Some of the refined-iron makers could dispose of larger tonnages, and there is not the same demand for special irons.

Scrap supplies are on a better scale, but there is still a good market for heavy machinery and ordinary heavy cast-iron scrap.

There is now more semi-finished steel about, although all consumers are not yet fully supplied. Re-rollers, however, are less hampered by shortages of material. There is a big home and export demand for black and galvanized sheets, but it would appear that British merchant bars are priced out of European markets. Belgian quotations are much below the minimum British prices, and business in British bars has fallen off to a somewhat disturbing extent.

Non-ferrous Metals

The Ministry of Materials has completed its discussions with the trade on arrangements for the release of zinc from its stocks during the first seven months of private trading after January 1 next. The Ministry has agreed to sell back to the agents of the United Kingdom and other Commonwealth producers 24,000 tons of zinc of their own brands. This metal will be available for immediate delivery as required throughout the first half of next year. Adequate supplies will therefore be available to meet consumers' requirements. No other zinc from the Ministry's stock will be placed on the market during this period, except for sales by the Government broker on the London Metal Exchange for prompt delivery when no other prompt supplies are available. Pricing of the 24,000 tons of zinc will be on the basis of the monthly average L.M.E. quotation over the six months from February to July, 1953, at the rate of 4,000 tons per month. None of this zinc will therefore be priced during the first month of free trading. There will be further discussions between the Ministry and the parties concerned if, in the light of experience, modification in these arrangements appears to be called for.

After consultation with the committee of the London Metal Exchange, the Minister of Materials has appointed Mr. F. C. Chisnell, managing director of the Anglo Metal Company, Limited, to act as Government broker for all sales of zinc by the Ministry on the exchange.

Statistics relating to the October usage of metals have been published by the British Bureau of Non-ferrous Metal Statistics. They point to the fact that the first month of the last quarter, which it has been suggested would show a decline on the figures for the earlier part of the year, made a good showing. In copper, for example, consumption was 51,578 tons, of which nearly 31,000 tons was in the form of virgin. The September total, it will be remembered, was 49,000 tons. For the 10 months to October 31, the 1952 cumulative total was 299,864 tons, compared with 273,025 tons in the corresponding period last year. Stocks of copper showed little change at 119,052 tons, the total at September 30 being 121,649 tons. Stocks of lead also declined by about 2,000 tons to 107,160 tons, the bulk of this, of course, being imported metal. There was a fairly sharp rise in the tonnage of lead used, for at 28,946 tons the October figure was up by 4,000 tons on September. Of this about one-third comprised scrap and remelted lead. Stocks of zinc again increased, and it looks as though we shall have a big tonnage on hand at the end of the year. The October figure was 142,615 tons, a rise of about 9,000 tons. Consumption at 22,264 tons showed an increase of about 1,100 tons on September. The October usage of tin at 2,066 tons was the best total since April and second only to January in the whole year.

Demand for lead shows signs of improving both here and on the Continent, where prices rather above the London level have been reported. In tin a satisfactory feature of late has been the continued narrowing of the premium for cash. Trading in scrap was again on a restricted scale, most of the business now transacted being for delivery in the New Year.

Much satisfaction has been felt over the announcement that as from yesterday (Wednesday), all restrictions on the use of copper have been removed. This is going to be a considerable help to the trade, and particularly to brassmakers, who could certainly do with more orders at the present time. No let-up has been announced in the use of nickel, but this will doubtless come in due course.

Official tin prices on the London Metal Exchange were as follow:—

Cash—Thursday, £947 15s. to £948 5s.; Friday, £945 10s. to £946; Monday, £943 to £943 10s.; Tuesday, £939 10s. to £940 10s.

Three Months—Thursday, £944 to £944 10s.; Friday, £943 to £944; Monday, £942 10s. to £943 10s.; Tuesday, £938 10s. to £939 10s.

Refined lead official prices, December and March:—Thursday, £96 10s. to £96 15s.; Friday, £96 12s. 6d. to £96 15s. (December), £96 10s. to £96 15s. (March). Monday, £98 to £98 10s. (December), £97 15s. to £98 (March); Tuesday, £97 to £97 5s. (December), £96 15s. to £97 (March).

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered, unless otherwise stated)

December 16, 1952

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 1s. 6d.; Birmingham, £12 15s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £16 8s., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £15 5s. 9d.

Scotch Iron.—No. 3 foundry, £15 19s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £17 14s. 6d. South Zone, £17 17s.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £18 14s. 6d.; South Zone, £18 17s.

Cold Blast.—South Staffs, £18 2s.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £16 2s.; Scotland (Scotch iron), £16 8s. 6d.; Sheffield, £17 3s.; Birmingham, £17 9s. 6d.; Wales (Welsh iron), £16 8s. 6d.

Basic Pig-iron.—£13 19s. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered.)

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45% Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75% Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 22s. to 28s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. to 11s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204 to £210 per ton; 38/40%, £235 to £265 per ton.

Ferro-tungsten.—80/85 per cent., 27s. 6d. to 28s. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 30s. 8d. to 35s. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60% Cr, scale 28s. 3d. per unit; 6/8 per cent. C, £80 17s., basis 60% Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr; max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 7s. 6d. per lb.

Ferro-manganese (blast-furnace). — 78 per cent., £49 0s. 8d.

Metallic Manganese.—93/95 per cent., carbon-free, £262 to £275 per ton; 96/98%, £280 to £295 per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 40s. to 60s. per lb., Nb + Ta.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 4s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £25 14s. 6d.; hard (0.42 to 0.60 per cent. C), £27 12s.; silico-manganese, £33 8s.; free-cutting, £28 8s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £31 9s.; case-hardening, £31 17s.; silico-manganese, £34 9s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 8s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 8s.; acid, up to 0.25 per cent. C, £31 17s.

Sheet and Tinplate Bars.—£25 3s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £29 14s.; boiler plates (N.-E. Coast), £31 1s. 6d.; chequer plates (N.-E. Coast), £31 3s.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £27 17s.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £31 15s. 6d.; flats, 5 in. wide and under, £31 15s. 6d.; hoop and strip, £32 10s. 6d.; black sheets, 17/20 g., £41 12s. 6d.; galvanized corrugated sheets, 24 g., £52 9s.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £50 18s. 3d.; nickel-chrome, £71 7s. 9d.; nickel-chrome-molybdenum, £79 2s. 6d.

Tinplates.—57s. 1½d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £285; high-grade fire-refined, £284 10s.; fire-refined of not less than 99.7 per cent., £284; ditto, 99.2 per cent., £283 10s.; black hot-rolled wire rods, £294 12s. 6d.

Tin.—Cash, £939 10s. to £940 10s.; three months, £938 10s. to £939 10s.; settlement, £940.

Zinc.—G.O.B. (foreign) (duty paid), £110; ditto (domestic), £110; "Prime Western," £110; electrolytic, £114; not less than 99.99 per cent., £116.

Lead.—Refined pig-lead: December, £97 to £97 5s.; March, £96 15s. to £97.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £130 15s.; rolled zinc (boiler plates), all English destinations, £128 15s.; zinc oxide (Red Seal), d/d buyers' premises, £136.

Other Metals.—Aluminium, ingots, £166; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £70 10s. to £71 (nom); nickel, £454.

Brass.—Solid-drawn tubes, 26½d. per lb.; rods, drawn, 37d.; sheets to 10 w.g., 291s. per cwt.; wire, 32½d.; rolled metal, 277s. 9d. per cwt.

Copper Tubes, etc.—Solid-drawn tubes, 32½d. per lb.; wire, 317s. 9d. per cwt. basis; 20 s.w.g., 346s. 3d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £195 to £218; BS. 1400—LG3—1 (86/7/5/2), £205 to £238; BS. 1400—G1—1 (88/10/2), £320 to £375; Admiralty GM (88/10/2), virgin quality, £325 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £350 to £385; L.P.Bl, £250 to £275 per ton.

Phosphor Bronze.—Strip, 413s. 3d. per cwt.; sheets to 10 w.g., 435s. per cwt.; wire, 49½d. per lb.; rods, 44½d.; tubes, 42½d.; chill cast bars: solids 4s. 2d., cored 4s. 3d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 9½d. per lb. (7%) to 3s. 10½d. (30%); rolled metal, 3 in. to 9 in. wide × .056, 3s. 3½d. (7%) to 4s. 4½d. (30%); to 12 in. wide × .056, 3s. 3½d. to 4s. 4½d.; to 25 in. wide × .056, 3s. 5½d. to 4s. 6½d. Spoon and fork metal, unsheared, 3s. 0½d. to 4s. 1½d. Wire, 10g., in coils, 3s. 9½d. (10%) to 4s. 10½d. (30%). Special quality turning rod, 10%, 3s. 8½d.; 15%, 4s. 2d.; 18%, 4s. 6½d. All prices are net.

Obituary

MR. HUGH RICHMOND, principal of Doncaster Technical College for the last five years, died recently at the age of 53.

MR. SYDNEY BAKER, governing director of S. A. Baker (Engineers), Limited, Salford (Lancs), has died at the age of 75.

MR. JOHN SPENCE, who died on December 6, was a director of Glencairn Metals, Limited, Motherwell (Lanark), having served the company for 33 years. He was 75.

MR. J. S. BOWDEN, a senior metallurgist at the Tin Research Institute, died recently. After graduating at Sheffield University in 1923, he served for some time with the Glen Irvine Iron & Steel Company, being employed later as a metallurgist with the Ministry of Supply. Mr. Bowden was 50 years of age.

THE DEATH has taken place at the age of 53 of MR. THOMAS H. GOULDBOURNE, sales director of Standard & Pochin Bros., Limited, manufacturers of heating and ventilating apparatus, of Leicester. He was appointed a director in 1939, and had been with the company for 25 years, spending all his time in the sales department.

THE COUNCIL OF INDUSTRIAL DESIGN and the Corporation of Birmingham, in an attempt to foster a high standard of design in outdoor seats, have arranged a competition for manufacturers, who are invited to send in prototypes or mock-ups of their new designs by April 30, 1953. Details are available from the Council of Industrial Design, Tilbury House, Petty France, London, S.W.1.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference E.P.D. or C.R.E. can be obtained from the Commercial Relations and Exports Department, Board of Trade, Thames House North, Millbank, London, S.W.1.

BEXLEY, January 3—Manhole covers and frames, gully grates and frames, and sundry castings, for the Borough Council. The Borough Engineer and Surveyor, West Lodge, Broadway, Bexleyheath.

CAMBRIDGE, January 3—Cast-iron kerb outlets, gully grates and frames, for the County Council. Mr. F. E. Bayliss, county surveyor, Shire Hall, Cambridge.

CORK, December 20—Hydrant tees, sluice valves, duck-foot bends, etc., for the County Council. The Secretary, Cork County Council, 7, Father Mathew Quay, Cork.

HARROW, January 2—Road castings, etc., for the Urban District Council. The Engineer and Surveyor, Council Offices, "Cottesmore," Uxbridge Road, Stanmore.

LONDONDERRY, January 1—Cast-iron pipes and specials, for the Rural District Council. Croasdaile & Taggart, consulting engineers, 36-38, Castle Arcade Buildings, Belfast. (Deposit, £3 3s.)

LONDON, W., January 19—Iron castings, lamp columns, etc., for the Borough of Ealing. The Borough Engineer and Surveyor, Town Hall, Ealing, W.5.

MAIDENHEAD, December 22—Cast-iron goods, for the Borough Council. Mr. C. T. Read, borough engineer and surveyor, 14, Craufurd Rise, Maidenhead.

MONMOUTHSHIRE, January 3—Gully gratings and frames, for the County Council. R. Cornish, Esq., county engineer and surveyor, "Stelvio," Bassaleg Road, Newport (Mon).

INDIA, December 22—Exhaust and blower fans, for the Director-General of Supplies and Disposals, Government of India. Room 7174 (CRE/40847/52).

INDIA, January 14—Supply and installation of equipment and plant required for a mechanized foundry unit for light castings, for the Director-General of Supplies and Disposals, Government of India. Room 5236 (CRE/40239/52).

THAILAND, January 19—All-steel high-sided wagons, for the State Railways of Thailand. Room 6176 (CRE/40373/52).

THAILAND, February 4—Bodies and underframes for covered goods wagons, for the State Railways of Thailand. Room 6176 (CRE/40374/52).

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CLASSIFIED ADVERTISEMENTS

PREPAID RATES : **Twenty words for 5s. (minimum charge) and 2d. per word thereafter. Box Numbers 2s. extra (including postage of replies).**

Advertisements (accompanied by a remittance) and replies to Box Numbers should be addressed to the Advertisement Manager, Foundry Trade Journal, 49, Wellington Street, London, W.C.2. If received by first post Tuesday advertisements can normally be accommodated in the following Thursday's issue.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order 1952.

FOUNDRY SUPERINTENDENT, aged 35-40, required by North-East Coast Engineering Company. Duties include co-ordination of planning and administration of all the company's foundry activities, and the supervision of production of C.I., bronze and steel castings in their modern foundry.—Send full details training and experience to BOX 3093, FOUNDRY TRADE JOURNAL.

FOUNDRY.—Wanted, young man to assist Metallurgist in Heavy Cast Iron Jobbing Foundry, Glasgow area. State age, wage and experience.—Box 3147, FOUNDRY TRADE JOURNAL.

FOUNDRY MANAGER for Non-ferrous Foundry, Manchester area. Must be keen disciplinarian, and capable of taking full charge. State age, experience, and salary required, also when at liberty.—BOX 3149, FOUNDRY TRADE JOURNAL.

A REPRESENTATIVE required, preferably with good connections with users of Grey Iron Castings and General Engineering Work. Basic salary, expenses, and opportunity to earn high commission.—Reply, in confidence, to MANAGING DIRECTOR., Gasel, Ltd., Leonard Street, Oakengates.

OLD-ESTABLISHED Firm of Diesel, Boiler and General Engineers in Home Counties has vacancy for ASSISTANT METALLURGIST. Should have sound knowledge of structure, heat treatment, physical properties of ferrous and non-ferrous metals, capable carrying out all chemical and physical analysis, reporting on composition and micro structure.—Apply, stating age, experience and salary required, BOX 3141, FOUNDRY TRADE JOURNAL.

METALLURGIST, age about 25, to take charge of laboratory and technical control in progressive Malleable and Cast Iron Foundry on east coast of Scotland. Candidates should possess initiative and be production minded.—Write, giving details of age and experience, to BOX 3140, FOUNDRY TRADE JOURNAL.

RATEFIXER AND ESTIMATOR required by Iron Foundry, mainly on loam and dry sand castings for general engineering up to 20 tons. Experience essential. House available within reasonable period.—Apply, stating qualifications, etc., to PERSONNEL MANAGER, Distington Engineering Co., Ltd., Workington, Cumberland.

SITUATIONS VACANT—*Contd.*

CHIEF METALLURGIST required for Steel Foundry and Engineering Works. Capable of controlling all phases of Metallurgical processes required for operation of Open Hearth and Converter Furnaces, with responsibilities for quality control. Staff pension scheme operating, and permanency to suitable candidate.—Apply, stating age, experience, and salary required, to THE MANAGER, David Brown-Jackson, Ltd., Salford Works, Hampson Street, Manchester, 5.

REQUIRED, for Ferrous and Non-ferrous Foundry in East Anglia, ASSISTANT SUPERINTENDENT. Applicants should have a good technical and practical background, and be able to supervise. A progressive and well paid position for right man.—Apply, giving qualifications, experience, and salary desired, in first instance to Box 3127, FOUNDRY TRADE JOURNAL.

EXCEPTIONAL opportunity for keen, conscientious, and fully experienced FOUNDRYMAN to become Partner in private Company of Ironfounders. Full control given on proved results. Minimum capital required £1,000, maximum £5,000. State fullest details of all experience in confidence. This offer is sound; only genuine persons capable of holding responsibility need apply. Attach copies of three references.—Box 3122, FOUNDRY TRADE JOURNAL.

ASSISTANT FOUNDRY FOREMAN required by London Foundry making medium weight general engineering castings. Opportunity for a young man age 25-30, with a practical apprenticeship in moulding and good technical training. Keenness and capacity for constructive work more important than supervisory experience.—QUALCAST (EALING PARK), LTD., Junction Road, S. Ealing, London, W.5.

METALLURGIST required for Steel Foundry Engineering and Chain Works. Previous Steel Foundry experience essential. Knowledge of alloy steels an advantage.—Apply, stating age and salary required.—SECRETARY, Brown, Lenox & Co., Ltd., Pontypridd.

RADIOGRAPHER required, preferably A.I.D. approval standard, and having experience with heat-resisting alloys, to start radiological section in investment casting foundry.—Apply in writing, giving particulars of training and experience, to JOSEPH LUCAS, LTD., Formans Road, Sparkhill, Birmingham, 11.

FOUNDRY ENGINEER. The International Meehanite Metal Co., Ltd., 66 Victoria Street, London, S.W.1, have a further vacancy for a position of Foundry Engineer. A knowledge of Grey Iron Metallurgy and Iron Foundry Practice is essential. This position offers exceptional opportunities of advancement to enterprising and adaptable man. Wide scope of operation. Knowledge of a foreign language desirable. Must be willing to travel in Europe. State full details of experience, technical education, age, and salary expected.

SITUATIONS VACANT—*Contd.*

K. & L. STEELFOUNDERS & ENGINEERS, LTD., Letchworth, Herts., have a vacancy for a young METALLURGIST for technical control and development duties in their Laboratories and Foundry. Applicants should be in the 22/27 age group and of gradnate or equivalent educational status. Foundry experience, whilst desirable, is not essential—more important qualifications being personality and a keen interest in steel founding.—Replies, detailing age, education and experience, together with an indication of salary required, should be sent to the PERSONNEL SUPERINTENDENT at the above address.

CROWN AGENTS FOR THE COLONIES

CHIEF WORKSHOP SUPERVISOR (FOUNDRY), Railway Department, required for the Gold Coast Local Civil Service for one tour of 18-24 months in the first instance. Salary according to age and war service in the scale £1,250, rising to £1,500 a year. Outfit allowance £60. Gratuity £150 a year. Free passages and liberal leave on full salary. Candidates between 25 and 45 must have served an apprenticeship in a foundry, preferably railway, and have had at least 3 years' subsequent experience in moulding. They must have a knowledge of metal mixing and the use of the various grades of moulding and core sands, and also have a sound knowledge of pattern making and shrinkage allowances. They must also have had experience in the operation and maintenance of iron cupola and oil fired brass furnaces and in the use of pyrometers.—Apply at once by letter, stating age, full names in block letters, and full particulars of qualifications and experience, and mentioning this paper, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W.1, quoting on letter M.33373.A. The Crown Agents cannot undertake to acknowledge all applications, and will communicate only with applicants selected for further consideration.

FOR SALE

NORWICH, NORFOLK.

ESTABLISHED Agricultural and Motor Engineers' Garage and Filling Station Business for Sale. Good position, City outskirts (Ring Road), comprising Showroom Offices, Service Bay, Stores, spacious Workshops, Paint Shop and Yard Space, whole containing ¾ acre. Three Petrol Pumps, Hydraulic Hoist and Compressor. Many Agencies held. Freehold. £6,500 s.a.v. Good opportunity in prolific Agricultural Area.—Sole Agents: R. C. KNIGHT & SONS, 2, Upper King Street, Norwich (Tel. 24289).

AGENCY

MODERN fully mechanised Malleable Foundry in Midlands requires SALES AGENT to cover Lancs and Yorks area. Must have practical Foundry experience and good contacts.—Box 3138, FOUNDRY TRADE JOURNAL.